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OLUME L. No. 1

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TO OUR READERS

YOUR magazine NATURAL HISTORY has been published for over forty years as a public service without profit.

Starting as a modest American Museum leaflet, it has become an important national publication.

Your encouragement and enthusiasm have made this possible

Back of NATURAL HISTORY is the Museum with its great explorations, vast collections, research material, and staff of renowned scientists interpreting life in its myriad forms.

NATURAL HISTORY aims to acquaint Man with the wonderful world of Nature so as to aid him in better understanding of his environment and of himself. This is also one of the Museum's great aims.

NATURAL HISTORY and the Museum are inseparably bound together—help for one means help for the other.

The war provides great opportunities for our scientists in essential war activity and for the Museum, in helping Man to understand and overcome many of the difficulties that lie ahead.

But the war unfortunately has caused heavy loss in endowment income and city financial support for the Museum and rising publication and circulation costs for NATURAL HISTORY.

The Museum and NATURAL HISTORY will carry on but are now compelled to call on you for co-operation and help.

To meet increased publication costs we have regretfully decided to raise subscriptions from three to four dollars, effective June 1st. Other magazines have also had to raise rates.

In addition to renewing your subscription we further ask you personally to secure one new subscriber. Please do this as a service for the advancement of scientific knowledge.

For the benefit of members who are willing to do more than this service and obtain many new subscribers, friends of the Museum make a generous proposal, described on the following page.

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A. Perry Osborn

Acting President
The American Museum of Natural History

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3. Payment of $4.00 must accompany each subscription.
4. Renewals will not be considered new subscriptions.
5. The attached envelope contains five subscription forms. Additional envelopes may be procured from the Membership Secretary.
6. In case of ties the tying contestants will be required to submit a letter of not more than 50 words setting forth the merits of NATURAL HISTORY, and the award will be made to the contestant submitting the best letter.
7. THIS CONTEST CLOSES ON SATURDAY, OCTOBER 10, 1942. ALL SUBSCRIPTIONS MUST BE RECEIVED ON OR BEFORE THAT DATE OR BEAR THE POSTMARK OF OCTOBER 10TH. THE WINNERS WILL BE ANNOUNCED IN THE NOVEMBER ISSUE OF NATURAL HISTORY.

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New York, N. Y.

LETTERS

Sirs:

. . . Incidentally, Natural History Magazine is one of the most interesting and worth-while magazines I have ever read and I should not like to be without it. I first became familiar with it through a medical friend who presented me with a year's subscription and I have taken it ever since. . . .

Norman C. Yarian, M.D.
President, Cleveland Orchid Society
Cleveland, O.

* * *

Sirs:

. . . Please send me another copy of your May issue containing that admirable account of eels and their admirers in all ages, for which payment is enclosed. The chart is especially valuable. . . . The whole article is a wonderful summary of what man knows of the eel, past, present and future. . . .

Henry G. Schneider.
New York, N. Y.

* * *

Sirs:

Having just renewed my membership for a second year, I wish to express my satisfaction with your interesting publication and my regret that I did not join the society sooner.

The articles on the dinosaurs by Doctor Brown I found particularly entertaining and hope that many others on the ancient world will follow. May I suggest that someone write on the nature of evidence accepted to establish the length of time for geological ages? Problems of the professional, such as the ancestor of the Eohippus, make the subject matter very realistic for the general reader, and I am very curious to know what serves the paleontologist for a chronometer.

Joseph P. Crockett.
Washington, D. C.

Such an article may be forthcoming.—Ed.

* * *

Sirs:

It always gives me pleasure to send in a subscription for the Natural History Magazine. I know of nothing so big for the money.

Anne A. Risley.
New York, N. Y.

* * *

Sirs:

. . . Acknowledging receipt of the first issue of the magazine Natural History. I think that I shall enjoy every moment that I spend reading this most interesting of magazines. Also received the Associate Membership card for 1942. . . .

Mrs. Annie B. Rollmann.
San Antonio, Tex.

* * *

Sirs:

The article "Feathered Fishermen of Bonaventure" by Joseph Gordon which appeared in the April issue of your magazine was most interesting. The language and pictures which Mr. Gordon used were extremely well chosen.

My classes in science found the article very enlightening.

We would like to see more articles by Mr. Gordon in future issues.

Kate R. Miller.
Baltimore, Md.

READERS are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

IMPORTANT NOTICE TO READERS

NATURAL HISTORY is not published during July and August. Those members, however, who wish to have their September issue sent to a temporary summer address are requested to notify the Membership Secretary, giving the date at which they will return to their permanent address.

Moulin photo

The avenue of the giants is now in the path of lumbering operations. Conservation begins with the citizen, and every American should share a feeling of pride in the natural beauties of the wilderness, which gave birth to so many American traditions. The Save-the-Redwoods League, a nation-wide organization established during the last World War, is an example of what a group of public-minded citizens, with the aid of their state governments, can do toward conserving Nature unspoiled.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME L—No. 1 ★ ★ ★ ★ ★ ★ **JUNE, 1942**

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Filter for Your Color Shots .... Charles H. Coles 50

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MEDICINE M

THE

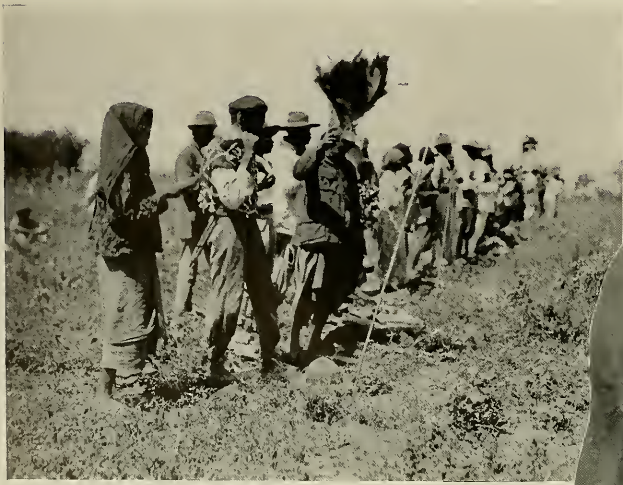
After centuries of superstition, the Mataco views a world half real, half imaginary

By Alfred Métraux
Smithsonian Institution, Washington, D. C.

*Photos by the author
except where
otherwise indicated*

(Below) **Wise** in the curative arts and folklore of his tribe: a Pilaga shaman. The belt is purely ornamental

A group of Matacos with medicine men expelling disease from their midst



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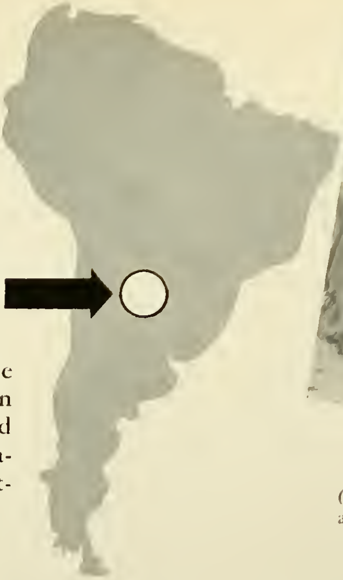
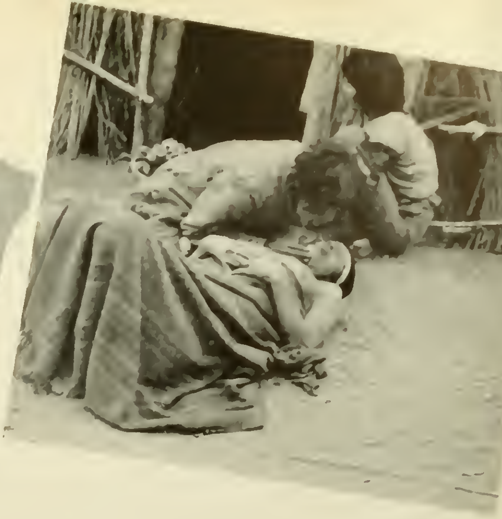


The bedside manner of the native doctor is a study in basic human emotions and an impressive demonstration of the power of spiritual beliefs



(Above) The native doctor is seen blowing on a patient to expel the evil spirit causing the disease

Anyone who has ever spent a night in the Chaco near an Indian camp will always remember the melancholy chants which, at dusk, fill the silence of the forest. They are produced by the medicine men who come to attend their patients after sunset. If you walk through a village then, you may see one by the dim light of the fire bending over a sick man, now entoning his monotonous chant, now stopping to suck the inert body until the skin is bruised or even bleeds. The operation is accompanied by energetic blowing, spitting, and mysterious muttered words and grunts. Suddenly the shaman gurgles and, retching as if he were about to vomit, removes from his mouth a thorn, a hair, or a live insect, which he shows the awe-stricken audience with the pride of a surgeon exhibiting a particularly fine appendix to his assistants. Alas, this is not the end of the treatment; in a moment the doctor begins again with renewed vigor and works until he has extracted another thorn or beetle from the afflicted limb. After several hours of hard labor he stops and generally predicts a prompt recovery.

The cure may take other forms, but this is the basic treatment for most diseases. Illness is almost invariably attributed to these odd objects which are thought to have been injected into the body of the victim by some malevolent witch. Whenever an Indian feels some discomfort, he immediately senses the threat of an obscure but hostile will.

The anger and resentment of a fellow tribesman are masked under the appearance of harmony, but for that very reason everyone is exposed to secret vengeance. A person who has been unintentionally offended or someone simply jealous of another's good luck can always give vent to his ill will by practicing black magic. Having stolen an object belonging to his enemy, he submits it to the treatment he wishes to inflict upon the unsuspecting owner. Or, if the plot is carried out by an expert sorcerer, the victim will be shot by invisible missiles, which penetrate his skin without causing any lesion. Once in the body, these effect their material appearance and, if they are not removed in time, cause death as surely as bullets would.

(Left) "Chief Negro" shaking the shamanistic rattle, which is widely used in ceremonies

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Alfred Métraux was born in Lausanne, Switzerland, in 1902. As a student of history, philology, and anthropology he attended the Sorbonne in Paris and the Göteborg Hogskola in Sweden. He holds a doctor's degree from the Sorbonne and is a graduate of the École des Langues Orientales Vivantes (African section).

For five years Doctor Métraux was the director of the Instituto de Etnologia de la Universidad de Tucumán in Argentina and editor of the *Revista del Instituto de Etnologia.* In 1934-35 he was the head of the Franco-Belgian expedition to Easter Island. During the next two years he worked as a Fellow of the Bishop Museum at Honolulu, and in 1938-39 he was a visiting professor at Yale University. From 1939 to 1941 he was a Guggenheim Fellow.

At present he is on the staff of the Bureau of American Ethnology of the Smithsonian Institution, Washington, D. C., where he is working on the *Handbook of South American Indians.* He has traveled extensively in the South Seas, western Africa, and South America, particularly in the Gran Chaco and in the Bolivian highlands.

Indians are so convinced that ailments are caused by the intrusion of foreign bodies that they attribute even the most minor troubles to such an origin. I remember an old man who consulted me about his foot which he said hurt him. The pain was slight, and there was no apparent infection; nevertheless, I yielded to his insistence and, hoping to comfort him, cleaned his foot with alcohol and scratched it lightly with a steel pen. Several hours later the man returned with a bright face and told me he was cured. He said he had heard a "shushing" noise and had seen black insects hurriedly leaving his limb. He explained that the liquid I had put on it had made the place too uncomfortable for the "beasts."

Near my house there lived a girl who complained of violent headaches. I gave her aspirins, but when these brought no results I advised her to call the medicine man. He ordered her to shave her head and then sucked her scalp for a long while. Later he brought me a huge beetle tied to a thread, which he insisted he had just extracted from the brain of his patient. In fact, when I saw the girl in the evening, she looked cheerful and well—"without the bee in her bonnet"!

The interpretation of disease as an intrusion of something into the body is at the root of the desperate fear shown by the Indians when a European doctor attempts to give them an injection. Even those who take medicines enthusiastically or who willingly undergo operations, become panic-stricken when a doctor approaches them with a syringe. They cannot be persuaded that any good will come from something that is *injected* into them.

I was told repeatedly by shamans that poisonous animals, such as snakes or spiders, kill people not by biting them but by actually getting into the body of those whom they attack. A little boy with whom I was walking around the village one day was suddenly bitten by a snake. I did my best to prevent the venom from spreading, but the Indians who had rushed to help the child did not approve of my endeavors. Several men chased the serpent and managed to kill it. They placed it next to the boy, remarking that even though the snake was dead its spirit was still alive and ought to know what had happened to its body. A shaman immediately started to chant. "Here I am," he cried, "I pray you, O serpent, do not do any harm. The poor little boy! Please go away!"

The serpent was supposed to have answered, "Well, I shall go. I have found my son, but first I want to be paid."

To satisfy its demands a woman hung necklaces over the patient as symbolic presents for the murderous snake. The shaman then proceeded to suck the skin of the boy's whole body with as much energy as he could muster. At last he spat into his hand and, pointing to a piece of mucus, he told me with a glimmer of pride in his eyes, "Look, these are the fangs."

He went on and after a while showed us the eyes of the snake and some of its vertebrae. I was completely baffled. After the cure had been completed I asked him how it could be that he had extracted the snake piecemeal from the patient's body when, in fact, the dead snake was already lying there in plain view. He insisted that it was the spirit that had entered the patient, but he could not account for its materialization; somehow the second snake both was and was not the same as the first one. Actually the cure was a great success.

There are other conceptions of diseases. They may also be invisible demons. The ugliest of all is Smallpox, who has a swollen head riddled with little holes. He lives in a cave in a mountain and travels at night looking for Indian camps. During a smallpox epidemic which I witnessed in the Chaco, the Indians had killed all the dogs lest their barking attract the attention of the hideous spirit.

When a demon has entered a person, the shaman organizes a dance in which the spirit invariably joins; after a while he tires of jumping about and begs to be left in peace. The shaman may also try to bribe the disease-demon by giving him whatever he wants. The spirit, when asked, generally demands a gun, an ornament, or some food. All his requests are satisfied at once, with the understanding that he will be content with the image—the "shadow"—of all these goods. To make sure that the spirit will not stick to the real offerings, the shaman blows on them heartily. But since the disease-demon may also have inserted some object into the patient's body, the medicine man must proceed with the usual sucking and blowing.

Many ailments result from the loss of the soul, which may have been kidnapped by an evil sorcerer, or, more exactly, by his soul. Kedok, one of my informants, told me that once when he was ill he consulted a famous medicine man. After much rattling and muttering, this practitioner declared that Kedok's soul had been taken captive while wandering abroad during his sleep, and that it was now imprisoned in a jail. The shaman went to its rescue. After flying to the sky and penetrating the earth he finally discovered it in a far-away place. Before getting it out of its predicament, he asked a handsome sum of money. He managed to liberate the soul, but as poor Kedok did not recover, the shaman had to admit that it had been re-taken. Finally Kedok turned to a real doctor for help and was cured.

Shamans are primarily doctors. Their essential function is to cure people, and all other activities are secondary. No one can become a doctor, however, without having been chosen in some mysterious way by a spirit. A man may be walking in the bush without thinking of anything in particular when suddenly he meets such a spirit. As a rule he does not realize that the friendly person who talks to him and accompanies him is a supernatural being. His new friend follows him into his hut and speaks until he falls asleep. Then the man dreams and sees in its real form the spirit which tells him that in the future he will be able to "chant" (that is, to "cure"), providing he spends some time alone in the bush. The person thus favored generally complies with the instructions given him and after a month knows the "proper songs."

One of my informants gave me the most colorful description of the novice shaman's experiences during his period of fasting and mortification. Whether this picture fits the facts I do not know. It is perhaps an ideal that no one entirely realizes. The apprentice shaman's food consists of small birds, a diet which he varies occasionally by eating raw dog meat, preferably dog's ears. "He becomes exceedingly lean and weak and for 20 days he does not stop trembling." He sings continually as if moved by a superior force. It is only when the urge to sing has died down that he emerges from his condition of semihallucination.

The vigil of the novice is followed by a ceremony in which an old and experienced shaman communicates to him his magic power. He comes close to the candidate and asks if he wants to become a medicine man. Then, addressing a magic stick, he orders it to enter him. The initiate crumbles as if struck by lightning. When he recovers he intones his chant. Henceforward he is a full-fledged shaman and can hurl at his enemies the missile housed in his entrails, or extract the projectiles which have wrought havoc in the body of a patient.

A shaman is also a man who has a familiar spirit which he consults when he wishes to know the future or when he must accomplish some difficult task. He crawls under a blanket and invokes his supernatural servant; after a while he begins to shudder and feels a shock as if someone had struck him—the spirit has taken possession of his body. He then carries on a long conversation with it and learns the secrets hidden from the common people. Quite often the possessing spirit urges the shaman to commit crimes. "I wish that such-and-such a man would die," says the evil one. "I wish that so-and-so would get sick." The shaman must abide by these orders.

Shamans, of course, ask fat fees from their clients. They rationalize their greed by contending that, if the patient fails to pay, not only will he become sick again, but, in addition, the insulted spirit will punish the shaman for his unselfishness.

The Mataco Indians have associated magic ceremonies with Catholic rites and, of a shaman who is invoking the spirits, they generally say, "He is saying mass."

The Mataco shaman sometimes changes himself into a white bird, or, more exactly, his soul is transformed. He does this by snuffing a powder prepared from the seeds of the cebil and by playing a flute made of bird bone.

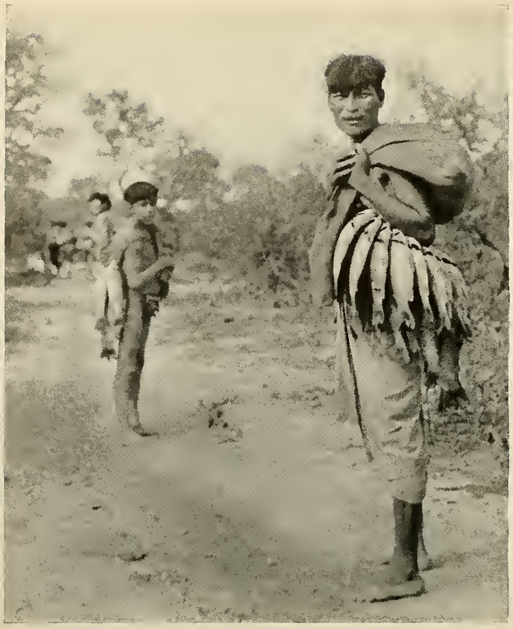
Once turned into a bird, he flies up into the sky, "just like an airplane" a modern-minded Mataco explained. The purpose of such a magic flight is to attack another magician who has kidnapped a soul and to force him to give it back. If men were clear-sighted, they could see in the sky the battles of the shaman's souls which, disguised as birds, pounce upon one another with the utmost ferocity. Shamans also fly to the sky to ask Rain to come. An Indian told me that the white people would have lost all their cattle if the shamans had not succeeded in convincing Rain to visit them.

Of all the celestial bodies the Sun is the most useful being that shamans may consult, but as he grows very weary of the many visits they pay him, he isolates himself and makes access to his abode as difficult as he can. Shamans, therefore, prefer to call on him in groups led by some famous and experienced man. If the wandering souls of medicine men meet those from other villages, they fight, and shamans whose spirits have been wounded or killed will inevitably fall sick or die, for whatever happens to the spirit must affect the body as well.

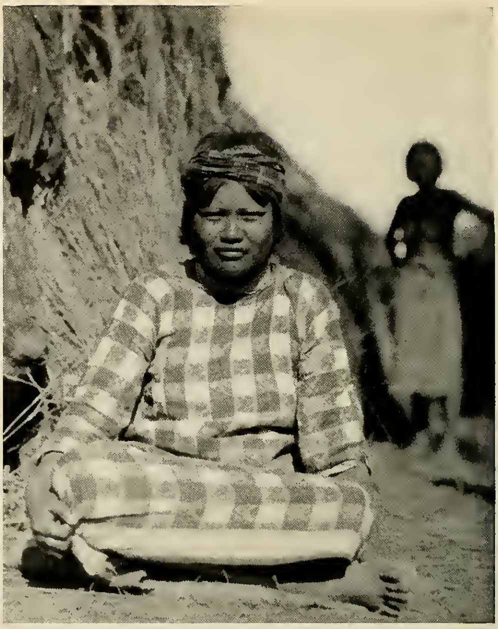
To protect the entrance to his hut, the Sun has made the trail leading to it slippery. Those who step on it, slide down and break their necks. Clever shamans know how to overcome the obstacle—by transforming themselves into wax they manage to stick to the trail. The Sun closes the gate of the fence surrounding his house with a trap made of two beams which move to and fro at such great speed that those who pass between are crushed. Skillful shamans change themselves into hummingbirds and fly unharmed between the onrushing beams before they meet. There are other traps within the gate in which naïve travelers are ensnared, but those who turn into eels slip through easily. The last obstacle is a palisade of cacti, which powerful shamans pass either as birds that fly over it or as rats that dig under it.

The Sun is generally perplexed by the visits of shamans who so easily dodge all his traps and snares. Every morning he strolls out to inspect his defenses and is amazed to find so few victims. This means that he must often go hungry.

Nevertheless, once a shaman has evaded the last trap, the Sun is no longer angry but receives his guest cordially. He even carries courtesy to the extreme of snuffing out his beams so that the visitor may come



A FISHERMAN of the Mataco tribe shows a good day's catch



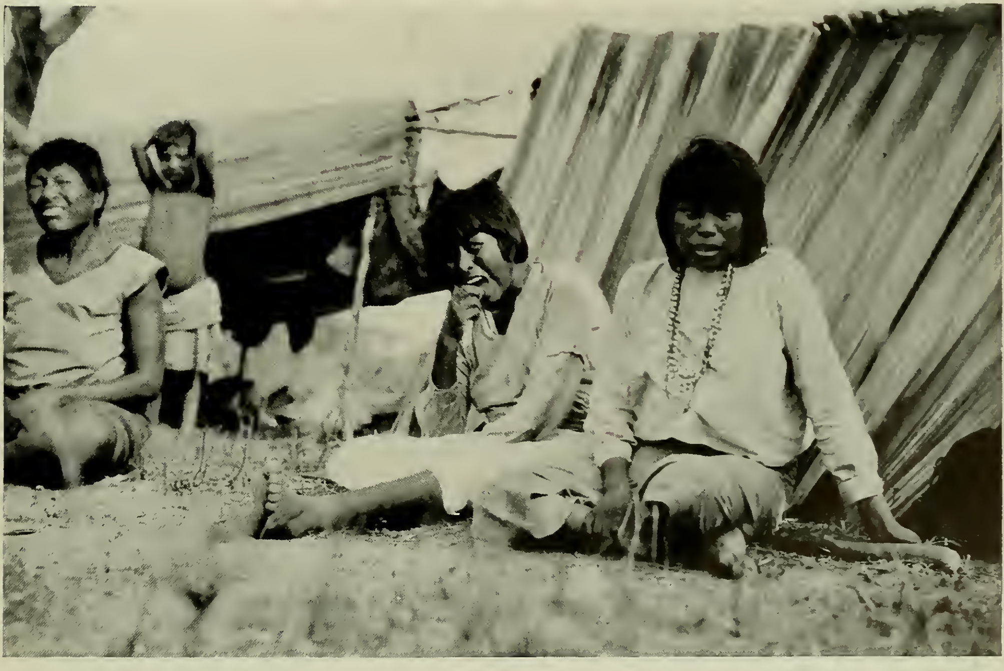
THIS GIRL belongs to the Toba tribe, also of the Chaco

A BROAD GRIN is possible even in the difficult life that is led by the Pilagas

The native mother recognizes that all time is playtime

The shy Toba girls watch the scientist with mild wonder

Photo by Guy Serge Métraux



near. The Sun opens the conversation by asking the shaman why he has come. The polite shaman is supposed to answer, "I came to have a talk, to call on you and to become your friend." Thus they become acquainted.

Other shamans prefer to visit the Big Fire at the end of the world. On the journey thence they must cross first a rainy area and then a dark region, over which they fly in the form of an owl, a bird with lanterns in his eyes. After passing the obscurity, they turn into aquatic birds with red-circled eyes to continue the trip. Finally they take the appearance of "beautiful and well-dressed girls," for Big Fire likes pretty women. Big Fire always inquires about savannas and dry forests, but the cautious medicine man always disclaims any knowledge of such places, for he does not wish the fire to spread over his country. After a talk, in the course of which the shaman asks Big Fire many questions, he returns home enriched with a wealth of information.

When the Indians are approached by missionaries, they will abandon their shamans if they are offered white medical care. It is by taking the place of the medicine man that the missionary gains the confidence of the natives. The eagerness with which the Indians accept treatment at the hands of European doctors is certainly surprising; they even carry their enthusiasm to the point of consulting the practitioner when they are in good health.

That their attitude is still governed by magical ideas is clearly shown by the importance which the Matacos, for instance, attribute to the stethoscope. No treatment is valid unless the mysterious instrument has been applied against the chest. Some people refused to see the doctor at their mission and traveled for 30 miles just to be put in contact with the all-powerful black tube.

Shamans, of course, resist the new ways as long as they can and, when they are converted, it is often with the hope that they will share in doling out the white medicine. I knew an Indian who opened a practice of his own. He was selling medicine in real druggist's bottles and even ordered pills from wholesale stores. His most powerful instrument was a pair of dark glasses, which he always put on before examining a patient. He claimed that with them he could see a person's insides. His reputation was particularly well established among the Argentinians living in the region, and every day patients, some of whom had traveled for two or three days, flocked to his cabin. White people referred to him simply as "the doctor." Once in a while Señor Doctor had to come to the mission to dictate a letter to his druggist, for he himself could neither read nor write.

The case is typical. In the end, surprisingly enough, even the white people in the neighborhood not infrequently become the shaman's clients, both the wealthy and the poor. How often have I heard a storekeeper or rancher who had suffered from some strange ailment, tell me that after consulting the most famous physicians in town to no avail, he had finally been cured by a local shaman.

It is no mean tribute to the old shaman, who has lost everything else, that the white invaders have turned to him in their hour of need when they felt powerless to fight disease and death.

(Above) DAUGHTER of the great chief of the Pilaga with her newly born baby, of whom she was extraordinarily proud

(Below) THE TOUGHEST field hockey player among the Pilaga

Photo by Guy Serge Métraux

(Below) THIS TOBA YOUNGSTER donned his most "beautiful" suit to have his picture taken

Photo by Guy Serge Métraux

A NOTORIOUS CHARACTER among the Toba girls who was always ready to pick a fight with other girls and was as pugnacious with her tongue as with her fists

A LONELY WARRIOR at an Argentinian fort who combined a military coat with war paints and a feather: one of the best hunters and "soldiers" of his band

YOUNG CHUNUPI GIRL, refugee from the Paraguayan war front, showing a reluctant baby

SEEING

Photographs by Winthrop N. Davey

The Sphinx

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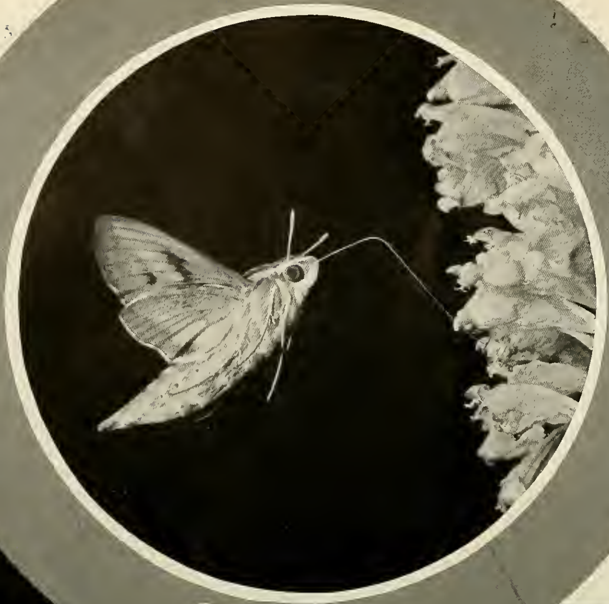

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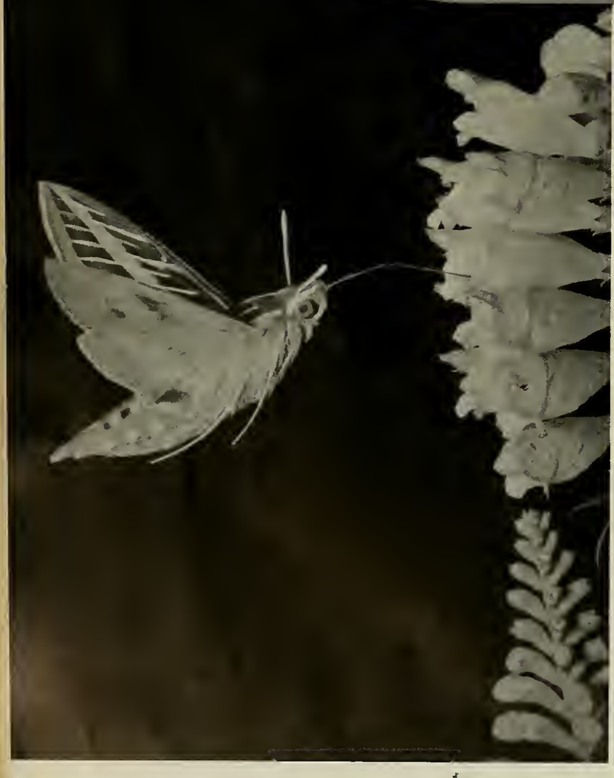

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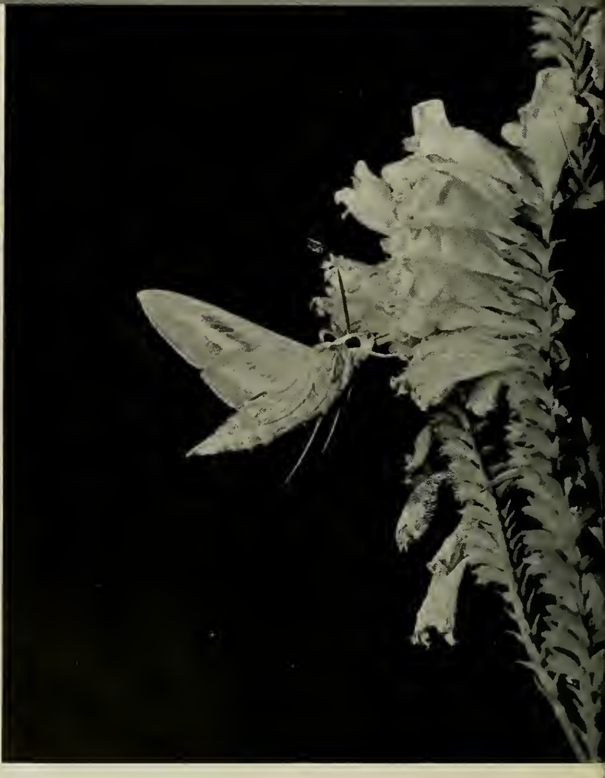
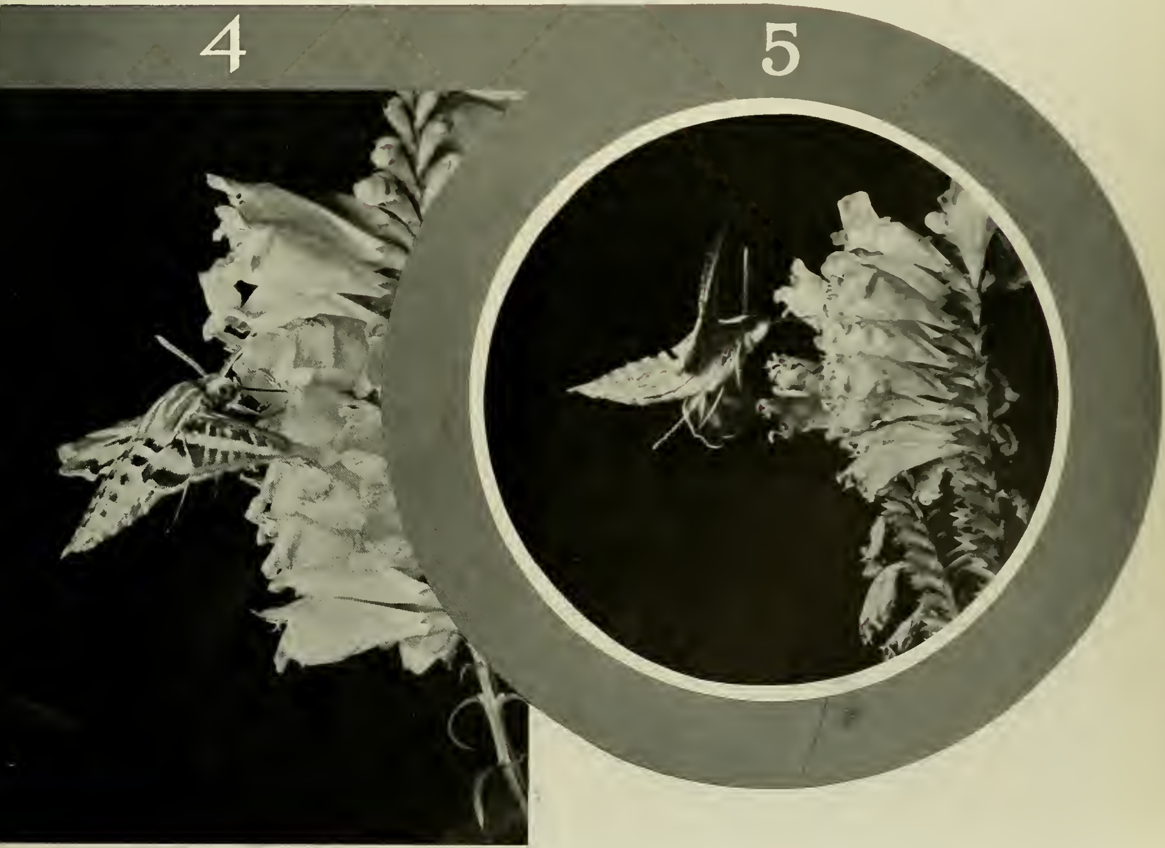
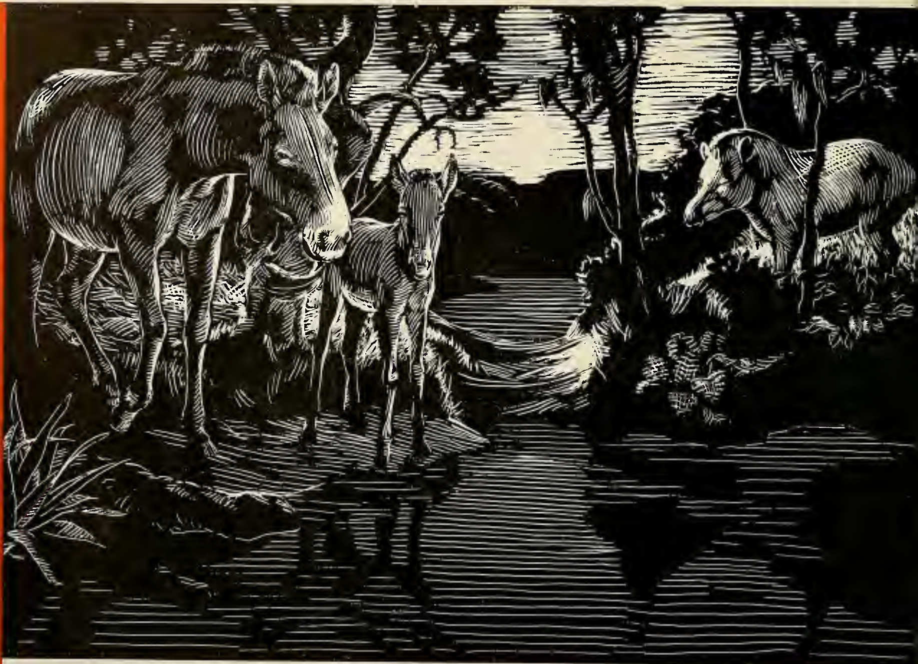


NATURE *through* the CAMERA'S EYE

THE marvelous possibilities of super-speed photography are clearly demonstrated by these five pictures. They reveal a process which takes place in thousands of back yards yet had never been clearly viewed by the human eye. The photographs were taken with Kodatron Flash Tube at 1/30,000 second. Mr. J. R. Davey, who submits them, writes: "I have been interested in high-speed lighting technique as applied to nature photography for the past year or so. Last summer I was able to lend my camera and lighting equipment to my brother, who is a senior medical student and has entomology and ornithology as hobbies. He took the photographs in September at Jackson, Michigan, where the white-lined sphinx moth *(Deilephila lineata)* is abundant around gardens."

Moth takes a drink

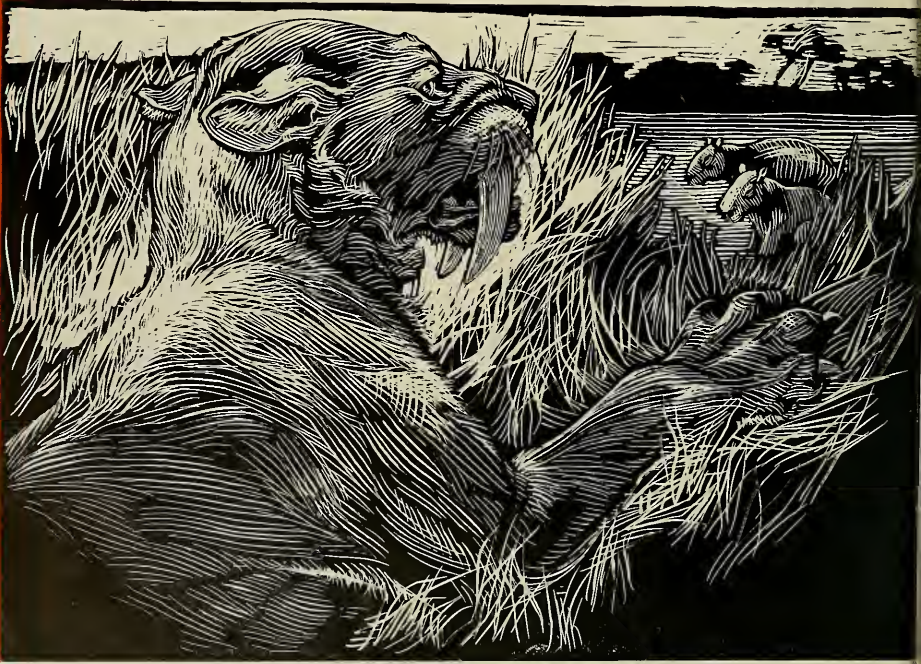




Long before white man set foot upon our shores, horses and tapirs had left North America, presumably for "greener pastures." But while the fourth great glacier was refrigerating most of the continent, both these plant-eaters were content to bask in Florida's mild climate

ICE AGE WINTER

Drawings by
Margaret Colbert

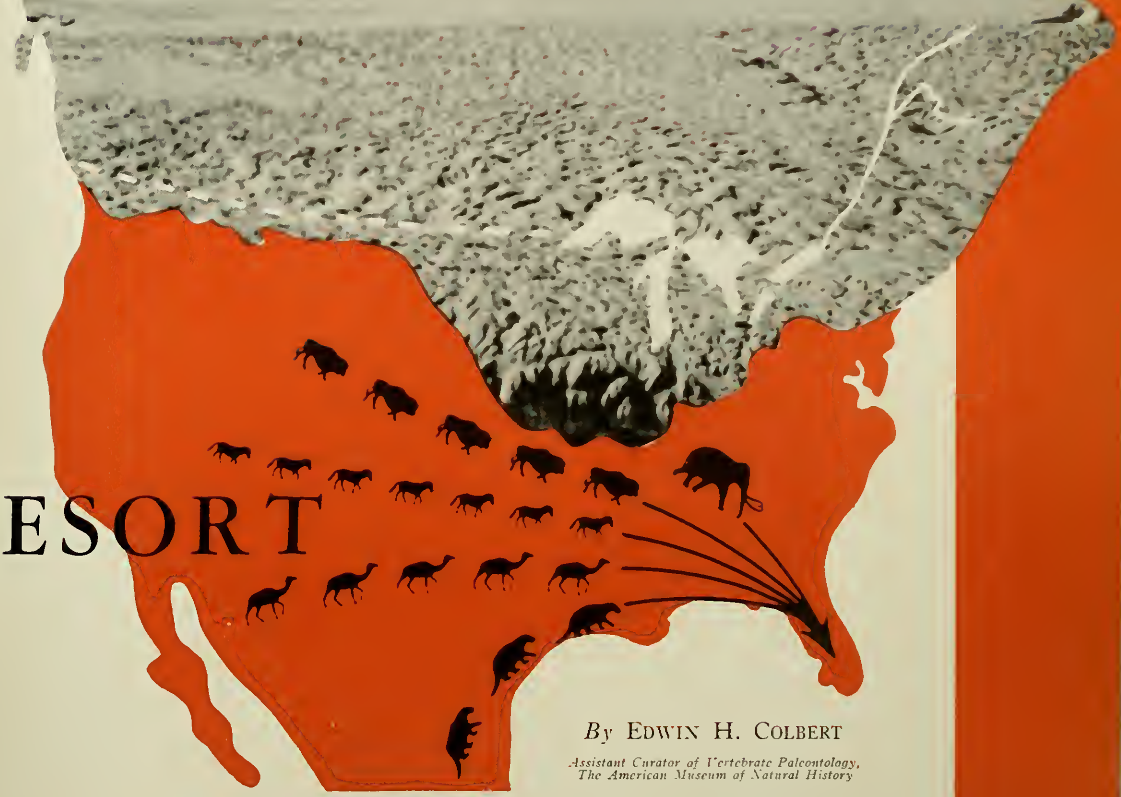


Arch-predator of the Ice Age was the powerful sabertooth. Small-fry ice refugees —the otters, skunks, weasels, etc.—lived in terror of this giant cat. The capybara (*right*) found a haven along the Floridian streams. Though extinct in North America, this colossus among rodents persists in South America

Last installment in the story of animal life

Driven south in a spectacular population movement by relentless glaciers that descended upon North America, the animals discovered Florida's warm haven a million years ago

RESORT



By EDWIN H. COLBERT

Assistant Curator of Vertebrate Paleontology,
The American Museum of Natural History

ABOUT a million years ago there began a series of new events of profound importance in the history of the earth. From the north, tremendous glaciers—icecaps of continental proportions—began to creep slowly southward to engulf the greater portion of North America, while at the same time in Eurasia, there was a similar southward advance of the ice sheets. These glaciers of the northern hemisphere pushed unceasingly down to the middle latitudes, and then, just as mysteriously as they had begun their advance they halted, and finally retreated to the polar regions from whence they came.

Four times this great encroachment of the land by continental glaciers occurred, and North America, Europe, and northern Asia became regions of polar frigidity. Four times the glaciers retreated and the northern continents became warm again. It is in the last of these glacial retreats, which began some 30,000 years ago, that we are now living. We are the inhabitants of a warm interglacial age, and there is no reason to think that our descendants, in the dim future, may not witness another southward push of the ice, inevitable and relentless. All of which is in explanation of the latest events in the long history of the earth, the great Ice Age which is known as the Pleistocene.

Obviously the first glacial advance, bringing with it cold, arctic conditions, was bound to have some effect upon the animals living in the northern continents, in North America, Europe, and Asia. The long period of gradually changing environmental conditions described in last month's issue of NATURAL HISTORY was at an end; here was the beginning of a new epoch, a period of relatively rapid changes in environment. To the new conditions the life of the earth had to adjust itself.

As has already been shown, many types of strange animals became extinct near the end of Pliocene times, even before the glacial advance had truly begun. The increasing rigors of the climate preceding the actual formation and southward push of the vast continental glaciers must have had much to do with the disappearance of the strange, highly specialized mammals of late Tertiary times. Consequently by the beginning of the Ice Age in the northern world many "modernized" types of mammals had made their debut upon the stage of paleontologic history, animals which were fitted by their adaptability to withstand the rapid and severe changes attending the first great glaciation.

The horse and his relatives the asses and zebras appeared with the advent of the Ice Age. So did the camels and the large deer of our modern world. So did the various cattle, and with them a host of antelopes and gazelles. So did the elephants. Indeed, the sudden appearance of these new, modernized types of animals affords one of the convenient ways for recognizing the opening of the Ice Age throughout the world. The words "throughout the world" give a true impression, for a striking feature of this period was the great intercontinental and in some cases world-wide movements of certain types of these new, modern mammals. Let us look for a moment at these "migrations," if so they may be called.

The horses had evolved in North America during the long reaches of the Age of Mammals. Suddenly with the beginning of the Ice Age they broke from the confines of their homeland to spread through virtually the entire world. To the south, they pushed across the newly-established isthmus to occupy all of South America. To the west, they poured across a land connection which at that time bound Alaska to Siberia, and spread throughout Eurasia, the Orient, and Africa.

With them went the camels and their relatives. The llamas, alpacas and their ilk went to South America, the large camels to Asia, the Orient, and Africa, again utilizing the Isthmian and Bering crossings which connected the continents.

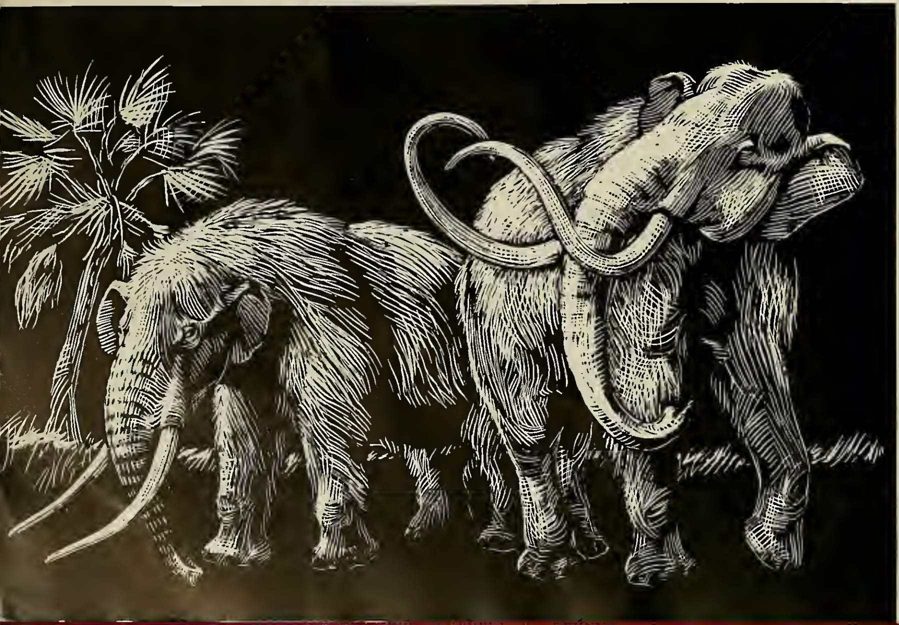
But all of the movements did not originate in North America, for there were corresponding flows in the other directions. The elephants, whose Pleistocene representatives are known as mammoths, originated in the Old World and crossed the Bering Bridge into the New World to occupy all of North America. With them came the cattle, specifically the bison, an immigrant which we think of as being the veritable symbol of America.

Bears and large deer also came from the Old World into the Western Hemisphere, although forerunners of these animals already inhabited this region; while from the opposite direction gigantic ground sloths, which had been evolving in South America, crossed the Isthmus to take up a new abode in a northerly environment.

These are only a few of the great movements of animals that took place with the coming of the Ice Age, but perhaps they indicate the extent to which the early Pleistocene was a period of animal migrations. Newly evolved animals pushed from one land to another, from north to south and south to north, from east to west and west to east. It seems as though a shuffling of animal populations was necessary to strike a new balance in the changed world.

These were the great movements that heralded the opening of the Ice Age. But what happened after these initial phases of the Pleistocene period had run their course?

We have already seen how there were four glaciations, how the ice advanced four times from the north polar region and how after each advance it retreated to the far north again. With these advances and retreats of the glaciers there were corresponding movements of the mammalian populations. As the ice came down from the north the mammals withdrew southward ahead of the glacial front. Then, during the interglacial stages, as the ice retreated to polar regions, the mammals spread northward again to occupy those regions from which they had been driven by the polar cold. Thus the Pleistocene animal populations may be thought of as pulsating communities, ebbing and expanding as the glaciers advanced and retreated, constantly shifting back and forth as the



MASTODONS AND MAMMOTHS also pushed their bulky weights to the Ice Age Winter Resort. Though conditions seemed ideal for their continuation, both disappeared from earth—leaving science with still another tantalizing "why?"

environment changed. Theirs was a life of rigorous changes, not within the experience of the individual it is true, but within the existence of the species. Such was the story of mammalian life in North America during the fluctuating course of the great Ice Age.

In all but one corner of North America—for in one small area the history of mammalian life seems to have differed from its general course over the rest of the continent. This is in what we may call the Ice Age Winter Resort—the peninsula of Florida.

As the glaciers pushed down from the north and crowded the animals before them, the influx of life into the southern portion of North America caused added pressure and competition during the glacial stages. Somewhere, somehow, a balance must be attained, or the pressure of animal populations would reach an explosive state. This balance was found, very likely, in the "safety valve" of Mexico and the Central American region. As the animals pushed in from the north, the southern animals retreated as best they could into the lower end of the North American horn. Thus by constant movements and adjustments the various animal populations could become more or less established in progressively smaller areas.

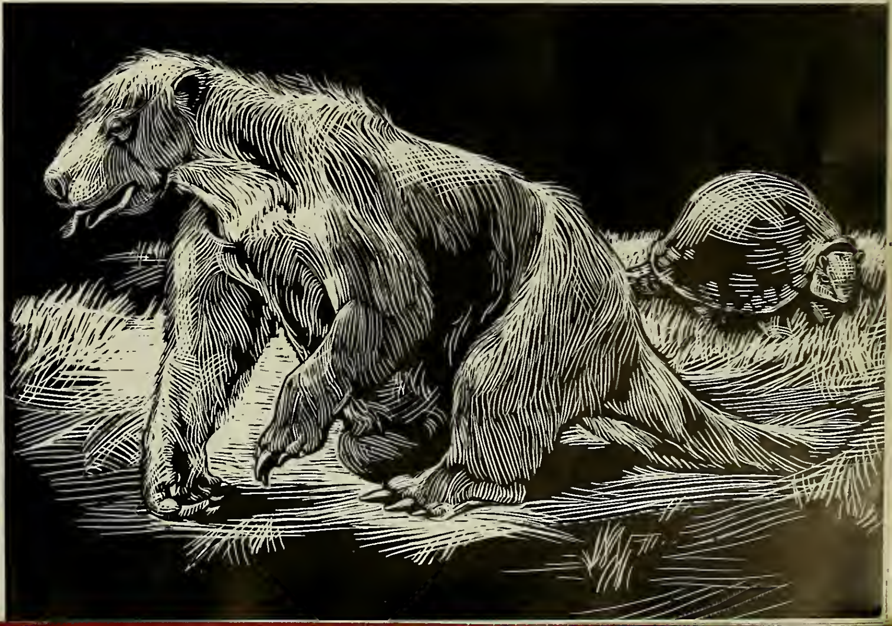
But on the eastern side of the continent such adjustments could not be made. Florida offered a warm haven for animals driven south by the polar cold, but it was a "dead end." Moreover it was a relatively small area, so that its accommodations for immigrating animals were necessarily limited. Consequently there seems to have been little penetration from the north, and life went on in Florida during the Pleistocene undisturbed by the flowing and ebbing glaciers. Here was an old-fashioned environment, with the rather monotonous conditions of existence that had prevailed over much of North America in earlier geologic ages. Here the tenor of life continued much as it had in the past.

To the eye of imagination, what would the Florida scene of that age look like? Very much as it does today, with certain additions. As in present-day Florida, there would be a host of small animals inhabiting the underbrush and hammocks, scurrying through the grass out of sight of the predator's eye. Here would be opossums and shrews, rabbits and various kinds of wild mice, muskrats, and squirrels. But splashing around in the streams in decided contrast to his tiny rodent brethren would be the large capybara, the giant among the rodents, now living far to the south in South America.

There would be numerous hunters such as are found in Florida today, the gray fox, skunks and weasels, raccoons, otters, and lynx. But dominating these pilfering seekers of small prey would be great, powerful predators such as one would hardly care to meet at close quarters. Fierce wolves would be seen loping across the hard open ground, while gigantic bears, long since extinct, would be found in the thickets. Great cats would be seen gliding through the forests like wraiths: the jaguar, found now in lands to the south, and the powerful saber-toothed cat, arch-predator of the Pleistocene, which disappeared from the earth thousands of years ago.

It is among the more peaceful types of animals, the grass-eating and browsing forms, that the Pleistocene fauna of Florida would seem strange to our modern eye. First one would encounter the bizarre giant ground sloths and the glyptodonts, immigrants from the south and cousins to the armadillo, an immigrant that still lives in this region. These were stupid and inoffensive animals, depending largely on their size for protection. The giant sloth probably could ward off the aggressive saber-toothed cat by using his hook-like claws, while the glyptodont, covered with a turtle-like shell, could pull in his head and offer passive but effective resistance to the enemy.

Then there would be the horses and tapirs, both living elsewhere today, but both destined to become extinct in North America long before white man set foot upon these shores. The horses fed in the open glades, while the tapirs, like their modern relatives, probably stayed along the streams, splashing through the water and browsing on the succulent leaves hanging over the banks. In the wooded stretches there

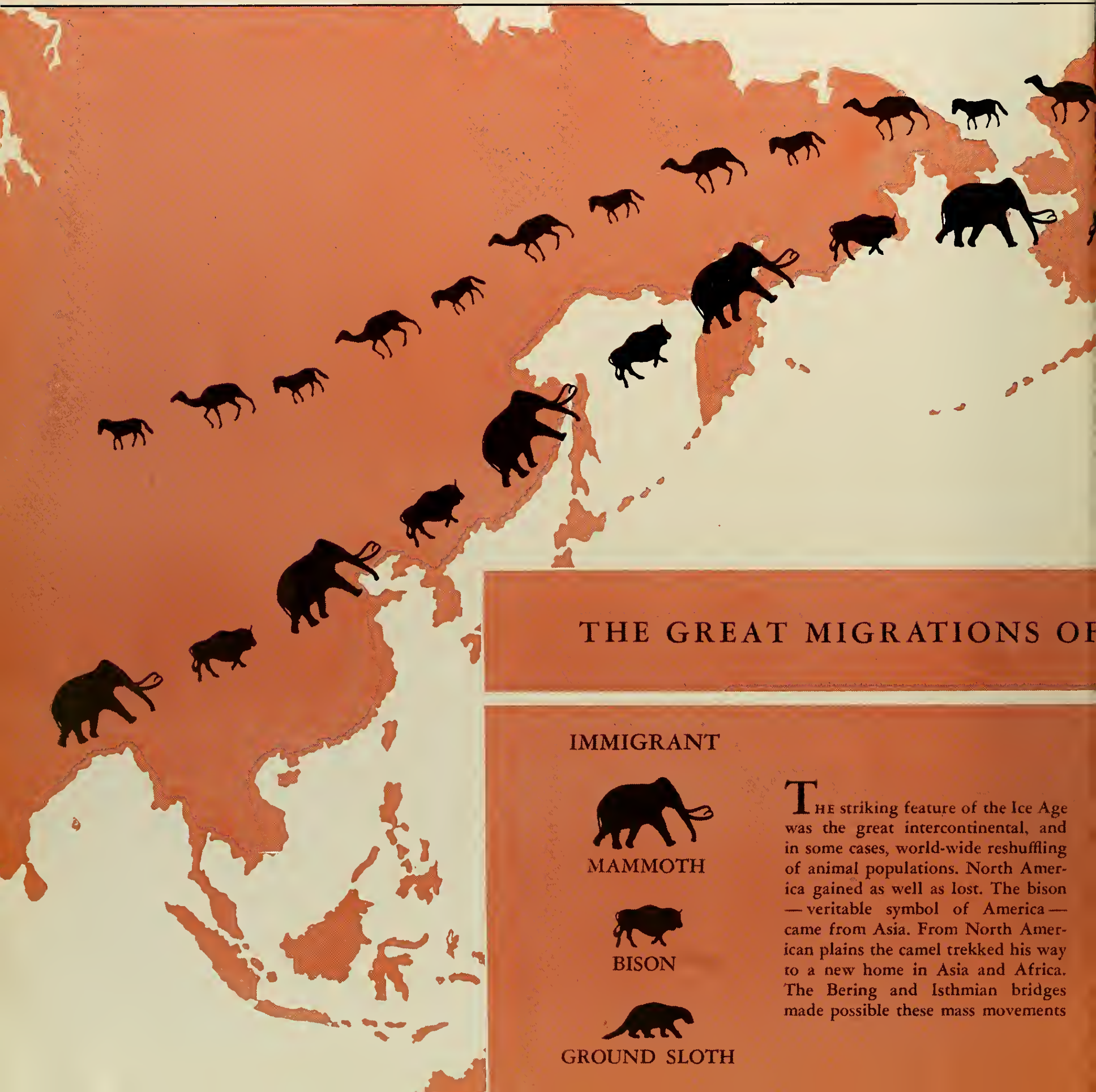


"NAILS IN HIS GLOVES." The hook-like claws of the giant ground sloth enabled him to ward off the attacking sabertooth. The turtle-like shell of the strange glyptodont (*right*) offered passive but effective resistance were large peccaries, pig-like animals whose much smaller cousins survive today in southern North America and the regions to the south. In the open spaces camels would be seen, grazing alongside herds of deer and black masses of large bison. And in the streams, sea cows and alligators would raise their heads as they swam along, even as they do today in Florida.

Finally there would be the gigantic elephant-like animals, the mastodons and the mammoths, crashing through the forests and stripping leaves from the trees with their powerful trunks. These were the dominant but tolerant lords of the entire scene, afraid of nothing but the elements.

Such was Florida in the Pleistocene. And such was North America during the warm interglacial stages of the Ice Age. The difference was that this picture continued in Florida with but little change throughout Pleistocene times, whereas over much of North America the landscape was altered by the advance of the glaciers. At such times many of the animals that enjoyed a relatively tranquil existence in the Ice Age Winter Resort of the peninsula were in other regions driven to the south by encroaching reindeer, muskoxen, giant beavers, and woolly mammoths.

Such was the Florida that was found by the distant forerunners of Ponce de León—the first men to come to America from Asia. That was many thousands of years ago—how many we do not know. What we do know is that early man in Florida was



THE GREAT MIGRATIONS OF

IMMIGRANT

MAMMOTH

BISON

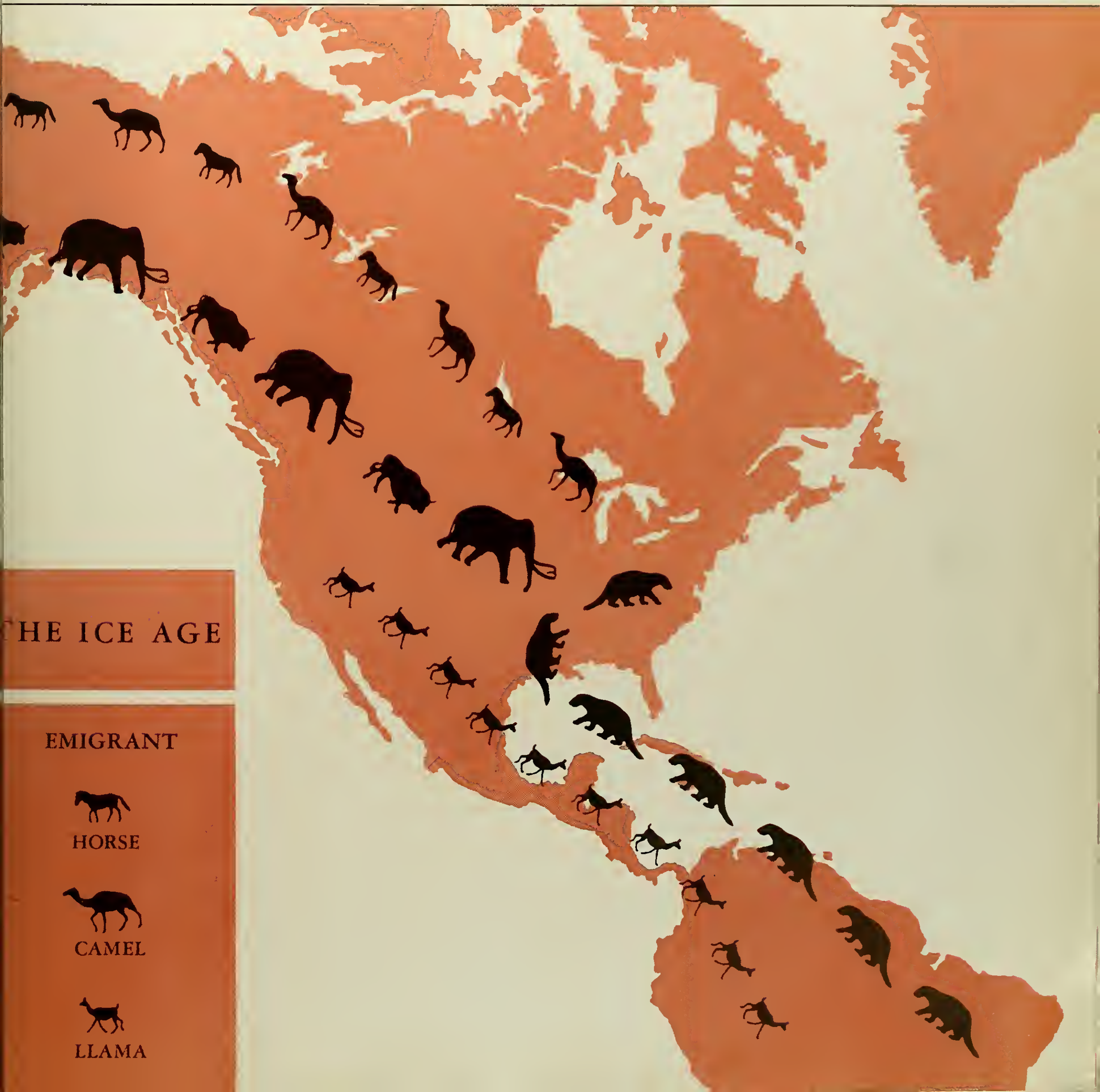
GROUND SLOTH

THE striking feature of the Ice Age was the great intercontinental, and in some cases, world-wide reshuffling of animal populations. North America gained as well as lost. The bison — veritable symbol of America — came from Asia. From North American plains the camel trekked his way to a new home in Asia and Africa. The Bering and Isthmian bridges made possible these mass movements living with all of these animals, with the types which still exist in this region and with those giants which long since became extinct in this land — the horse and tapir, the capybara, the saber-toothed cat, the ground sloth, the camels, the mastodon and the mammoth.

Why should these animals have become extinct, particularly in a land that seemingly was so amenable and so well suited for their continuation? This is a tantalizing question to which we shall probably never know the full answer. Suffice it to say that the great, dominant mammals of the Pleistocene became extinct all over North America *after* the arrival of man on this continent. Did man have anything to do with their disappearance?

Whatever the cause, the fact is that they did become extinct, but not until after the last glacier had begun its retreat to the north. Thus the "modern" period of our earth history was ushered in. Florida, the Ice Age Winter Resort for the Pleistocene mammals became the winter resort for modern man. The rest of the continent, subjected to periodic alternating cold and warm epochs, again became temperate.

But are we at the end of the cycle? Who knows but that in some future period, some tens of thousands of years hence, our descendants, perhaps completely civilized by that time, will really find Florida more than a winter playground? Perhaps it will be for them a haven, far removed from the great, crushing front of the fifth continental glacier, riding down over our northern cities.



Death in the Desert

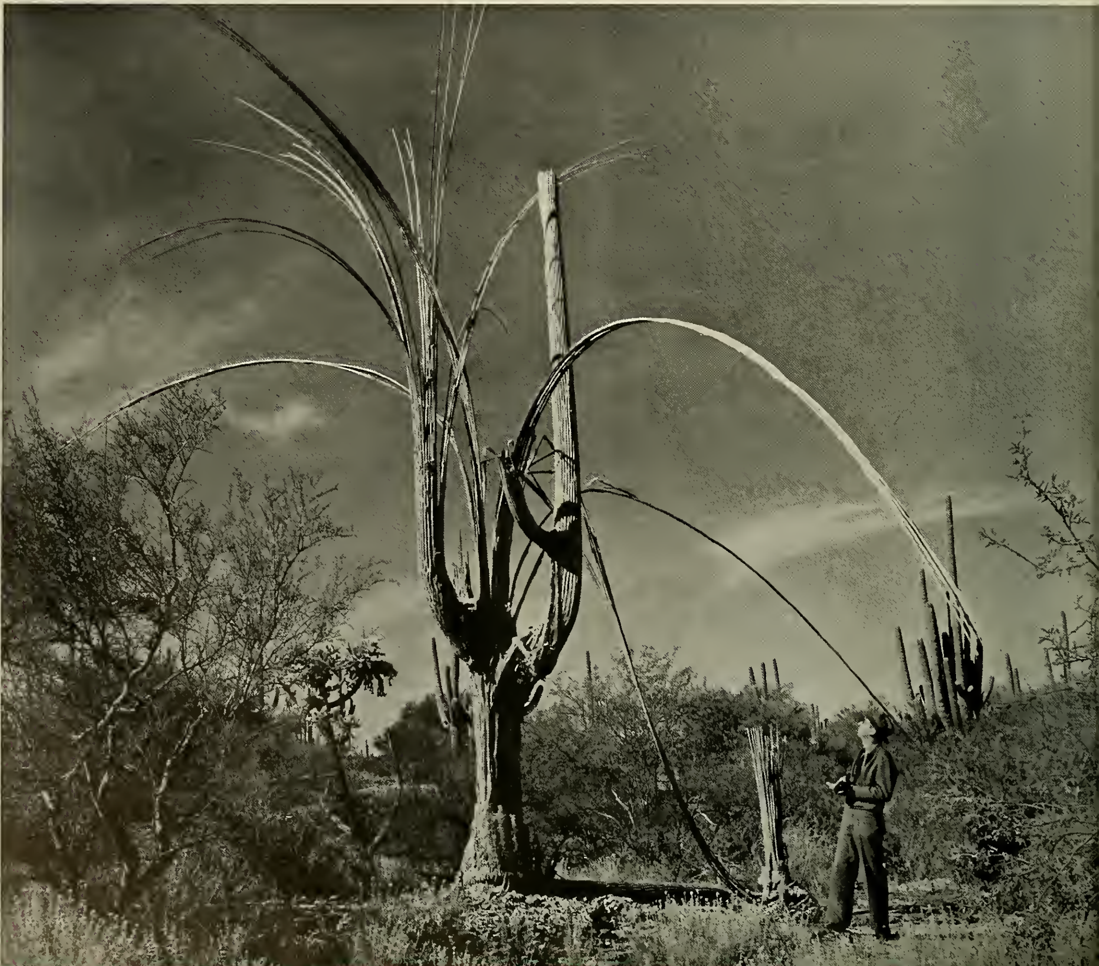
By LAKE S. GILL

Senior Pathologist, Bureau of Plant Industry, United States Department of Agriculture

ALL PHOTOS BY CHARLES W. HERBERT FROM WESTERN WAYS

The giant cactus, which has attracted the interest of so many travelers in the Saguaro National Monument just east of Tucson, is one of the most picturesque features of the south-central Arizona landscape. Its purplish-red fruit is harvested by the Indians and is either eaten fresh or boiled down to produce a molasses-like syrup and fermented. Some of the oldest giants are estimated to exceed 200 years in age. Recently a virulent stem rot has threatened to exterminate the giant cactus. Measures are being taken to curb it, as shown in these photographs. The seriousness of the plague is apparent when it is realized how slowly fresh seedlings can replace the fallen giants. A ten-year-old saguaro is rarely more than five inches tall.

KILLED by a virulent rot that has attacked the picturesque saguaro cactus of the southwestern desert, the ribs of this giant sway in the wind



(Right) A ONCE PROUD giant tumbles earthward, pulled over by a truck where the least possible damage will be done to the desert shrubbery

THE giant cactus or saguaro [suh-wah'ro] with its grotesque body and clumsy arms, attaining a height of 40 feet or more, may be taken from the southwestern landscape by a tiny bacterium.

In the summer of 1939 Prof. J. G. Brown, veteran plant pathologist at the University of Arizona, noticed that the saguaros around Tucson and Phoenix were dying at an alarming rate. Suspecting that a transmissible disease might be rampant in the giant cactus forests, he immediately sought an explanation, and within a few months he discovered what appears to be the trouble-making germ. News of his findings aroused the concern of Arizona citizens who prize these plants highly.

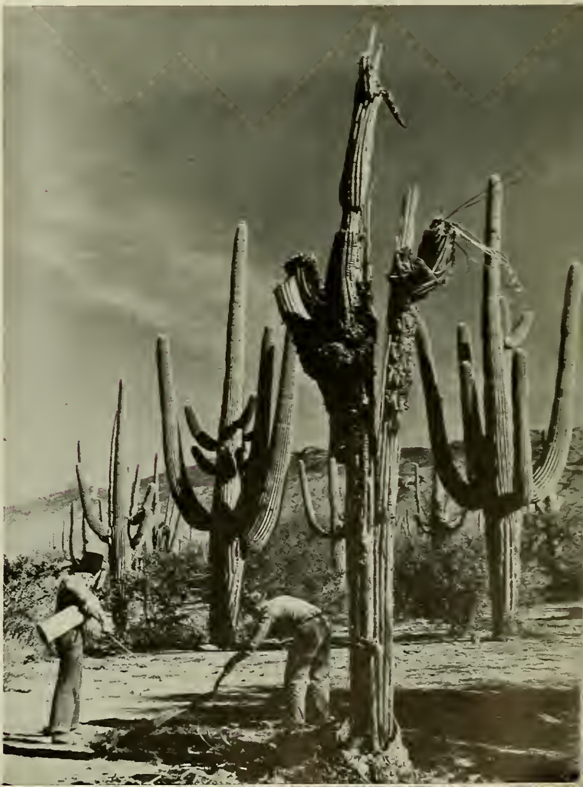
The saguaro, technically called *Cereus giganteus* or formerly *Carnegiea gigantea,* has come to be emblematic of the Southwest. Its white wax-like blossom is the official flower of Arizona, in which State the species is mainly found. South of our border it is abundant well into Sonora, Mexico.

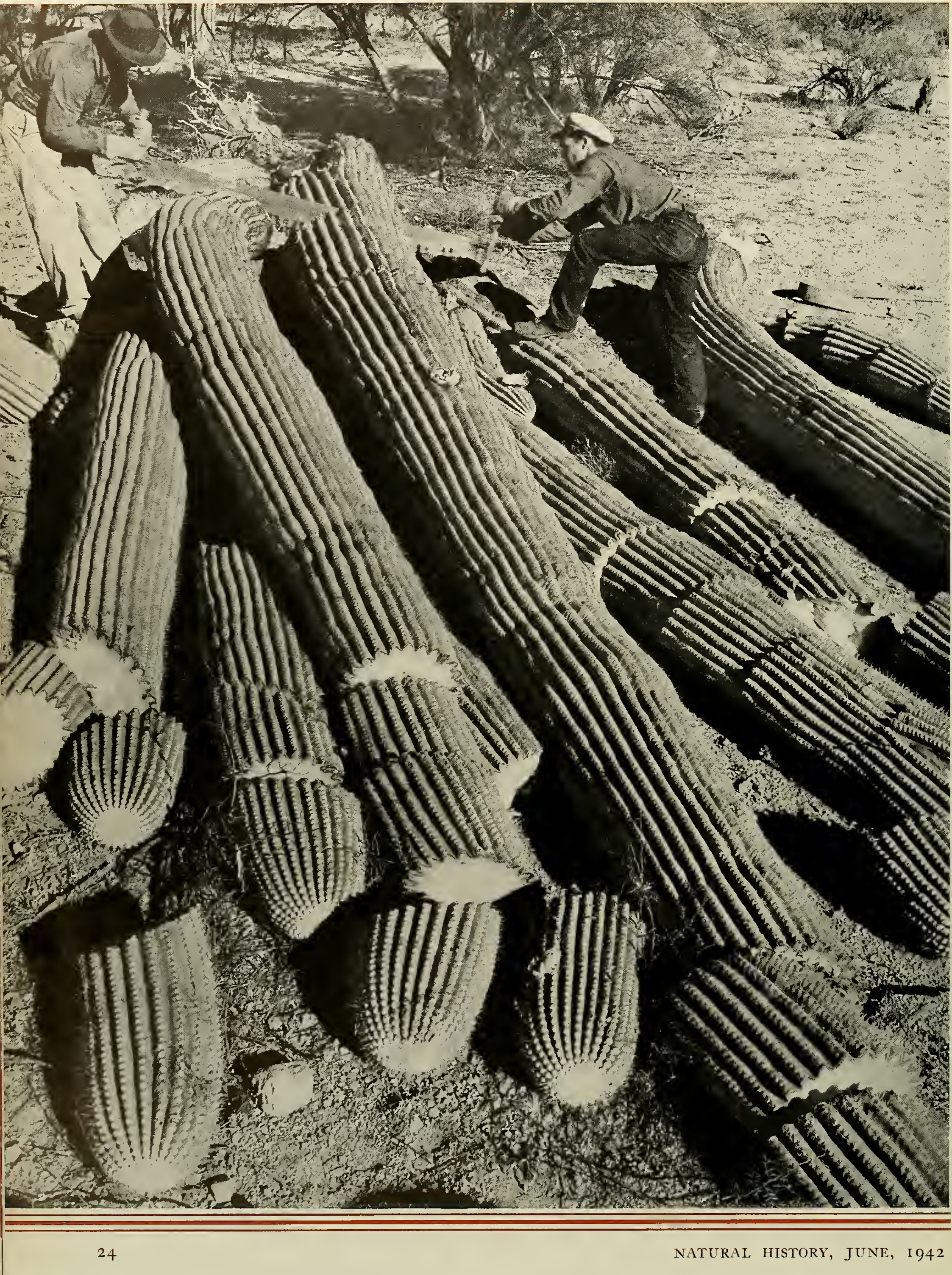
In addition to having great aesthetic value, the giant cactus affords food and shelter to the birds and mammals of its desert domain. The elf owl is said to live exclusively in holes made by the Gila woodpecker in the saguaro. The fruit is eaten extensively by coyotes and white-winged doves. Papago Indians make both a drink and a preserve from the delicately sweet fruit, grinding the tiny black seeds into a meal for their own consumption, or using them for chicken feed. The tough woody ribs are used in the construction of shelters and corrals, and in recent years have been employed in the production of knickknacks and novelty furniture. The stout sharp spines are sold for phonograph needles.

The cacti afflicted with this disease literally rot away. Their normally crisp, white, fleshy pulp turns brown, putrid, and slushy, and slips from the woody skeleton to the ground below, and there dries into a light crumbly mass. In early stages of attack, the putrified tissue is often confined to a pocket, sealed over by the tough outer skin of the cactus. Whenever this skin cracks, a sticky black liquid oozes down the outside of the plant. Sometimes open cankers form and slowly and insidiously enlarge until after many months they girdle and finally kill the cactus. In certain cases the rot may develop so quickly that there is no outward indication of disease until the decayed pulp suddenly slips from the entire skeleton, forming a sloppy heap upon the ground.

The National Park Service, custodian of some of our finest cactus forests, was among the first to ask how serious this disease was and how it could be checked. Last year the Bureau of Plant Industry, of the U. S. Department of Agriculture, joined the University of Arizona in a co-operative effort to answer

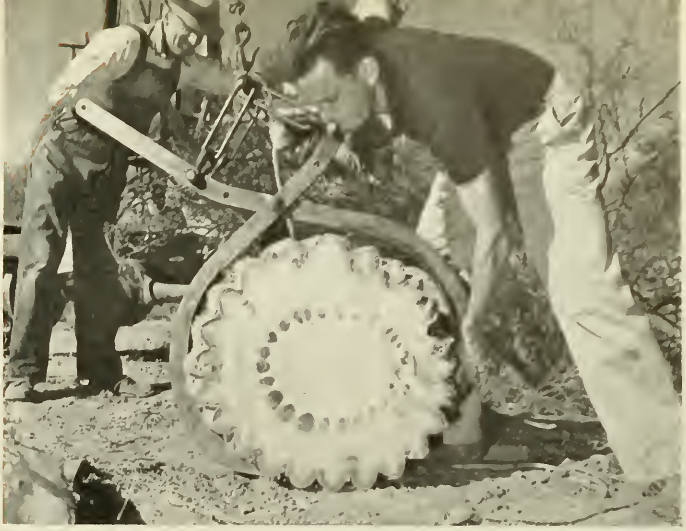
(Below) THE GROUND where a diseased cactus has been removed is sprayed with a bactericide after all debris has been removed. The skeleton in the forground is that of a giant that has been dead for several months; later this will be removed and burned



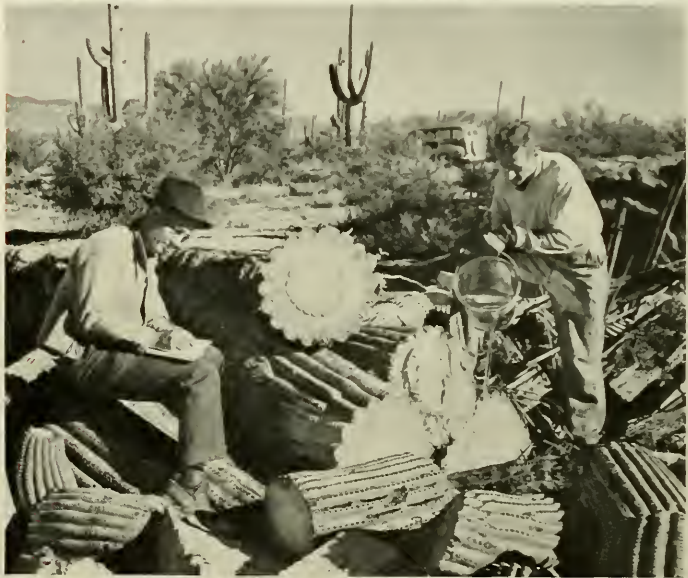


(Left) In order to get the massive giant cacti to the burial pits in dump trucks, they are sawn into short lengths

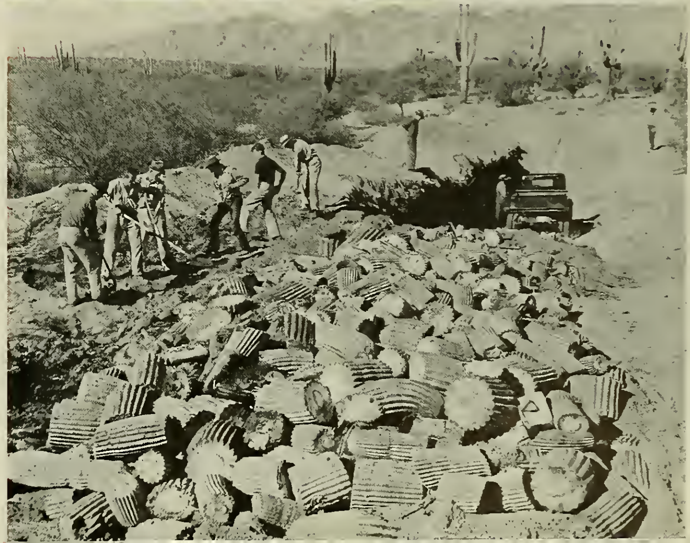
(Right) A portable crane is used to load the large butt sections. This one, which was five feet long, weighed about 1500 pounds

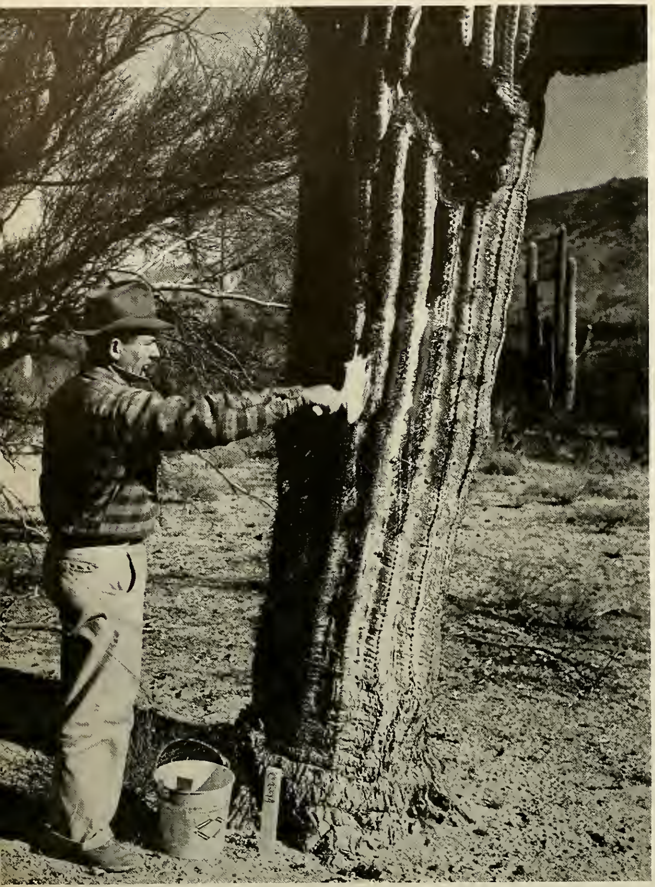


After the sections have been dumped into the burial pit, a volatile insecticide is poured over them and they are then covered with tarpaulins for several days, thus forming a lethal gas chamber for any insects present that might carry the deadly disease germ



After fumigation, the sections are permanently covered with dirt





(Above) A WHITE DAUB of paint is the death warrant for a seriously diseased cactus in the experimental plot. Note the record stake at base of trunk and disease lesion in stem

these questions by field and laboratory experiments, which should in due time yield the essential facts.

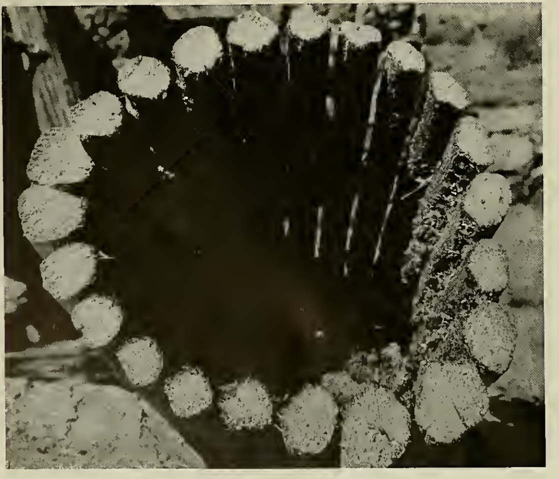
Professor Brown, with some assistance from the Federal Government, is making intensive studies of the germ he discovered. He hopes to determine its exact role in the disease, how it is carried, and whether it is a new and especially virulent parasite or a native organism, possibly one which constitutes only a temporary menace. For many years it has been known that saguaros seem to die of rot, but the casualties were so slight that they occassioned no alarm.

In preparation for the worst possibility—that a new disease was threatening to wipe out the saguaros in the same way that the chestnut blight exterminated the chestnut from eastern forests—, the Bureau of Plant Industry has started experimenting with suppressive measures. For the first test a square mile was set aside in the Saguaro National Monument east of Tucson. Diseased cacti in one half of the section were removed or treated, while the other half was left untouched for comparison.

In an ordinary plant-sanitation project, the diseased material would be burned, but this is almost impossible in the case of the saguaros, which contain more than 90 per cent water by weight and are extremely resistant to the hottest flame. Burial therefore, seemed to be the most practical method of rendering the badly diseased cacti harmless to the remaining stand. When the last of the 335 giants that had to be disposed of were covered with dirt, the skeletons and shriveled dry carcasses of the 1061 plants were piled in the graves and burned. The last vestiges of disease were then removed by operating on those cacti that were so recently infected that all rotten tissue could be cut out without seriously injuring them. Already there are indications that surgery applied at an early stage of the disease may effectively save a cactus from premature death.

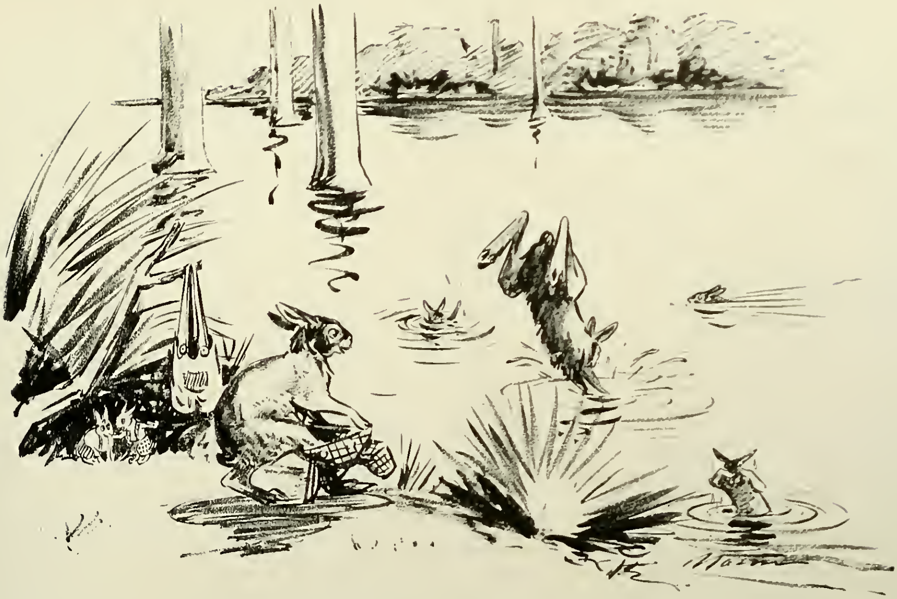
Each of the 13,125 cacti on the square mile has a numbered wooden stake at its base. These serve as identification marks for the case histories that are now being kept to determine the effectiveness of the treatment. Preliminary analyses of these records show that the death toll is heaviest among mature plants from 150 to 200 years old. If this age class only should be seriously attacked by the disease, it would take decades to restore the damage.

Saguaros reproduce by seed alone. The rare seed that manages to survive the vicissitudes of the desert is nearly always one that happens to fall beneath some hardy shrub. Shaded there and protected through the tender years, the young cactus is in time well-equipped to store away water for use during the droughts and able to shift for itself. It would seem that the giant cacti's way of life is already hard enough without having to cope with a devastating disease.



AFTER the outside pulp rots off and the central pith rots out, the tight hollow bundle of tough woody ribs that constitutes the skeleton of a dead saguaro can be used in the manufacture of unique furniture. Short bolts from large plants make interesting waste baskets; the skeletons from smaller plants are used for table legs or pedestals

RABBIT SWIMMERS



By JOHN ERIC HILL
Drawn by
G. FREDERICK MASON

RABBITS and their relatives generally avoid water and are as little given to swimming as cats. But in the southeastern United States, from the Dismal Swamp to southern Florida and west along the Gulf Coast to near Mobile, there is a species known as the marsh rabbit *(Sylvilagus palustris)*, which always lives in the moist lowlands and often goes swimming. A related species occurs in the Mississippi region, north to Illinois and southeastern Kansas and west to eastern Texas. In some parts of its range, this more western species is quite as aquatic as the marsh rabbit, but in other localities it is found in the dry wooded bottomlands, under conditions hardly different from those suited to the common cottontail.

Although most species of eastern North American mammals were known before the beginning of the nineteenth century, it was not until 1836 that the marsh rabbit of the Carolinas was described by Bachman. A few years later the *Quadrupeds of North America,* a work by Audubon and Bachman that established American mammalogy on a solid foundation, gave an account of the marsh rabbit's habits that comprised all that was known about this animal until recently.

The marsh rabbit lives in the low marshy regions, places that are subject to flooding by rain or tide, or near the permanent water of the great swamps. Here it makes runways and wades through the sticky mud or muddy pools. When going slowly the marsh rabbit often walks by alternate movements of the legs, instead of hopping as other rabbits invariably do. In swimming across pools and streams, it uses its legs in alternate strokes, somewhat like a dog, whereas the rare records of other kinds of swimming rabbits indicate that they move their hind legs together, as on land.

DO NOT MISS

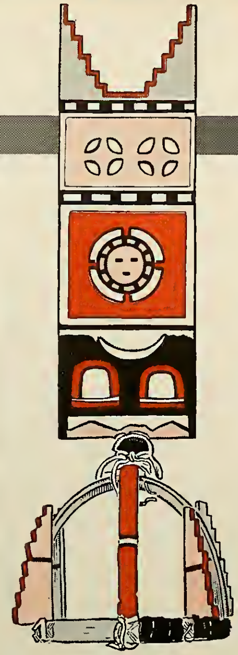
In **THE TALKING DRUM FROM MANGBETU LAND,** Dr. James P. Chapin, veteran Congo ornithologist, will recount an engaging series of adventures he had while securing one of the Museum's prized possessions from the Dark Continent. Dr. A. I. Good, who has resided for many years in West Africa, will explain for the first time in any popular magazine the system whereby the natives communicate by means of the drum.

•

In **DESIGN FOR SWIMMING,** G. Miles Conrad, the author of "The Film of Life," will examine Nature's varied bag of tricks for underwater locomotion and show how Man has applied her dynamic principles to such sinister agents of destruction as the submarine. A popular and thoroughly fascinating survey of the aqueous medium and the life it supports.

Although in some localities the habits of marsh rabbits are different, in the Carolina swamps they almost invariably take to the water for safety and swim with enough rapidity to escape from most dogs. A few years ago men on a dredge 700 feet from the nearest bank of the Savannah River were surprised to see a marsh rabbit swimming near them. No tide or flood could have brought it there, as far as could be determined. Apparently it was crossing the river just "to get to the other side." This seems to be a rabbit Marathon record.

Bachman told of seeing a number of marsh rabbits swimming about in a deep pool, "pursuing each other, as if in sport, and evidently enjoying themselves." Sometimes they hide in the water, almost like frogs, floating quietly with only their nose and eyes above the water and with their ears laid flat. And captive marsh rabbits like to lie partly submerged in water, especially in warm weather. In these habits they are not so different from ourselves in the "good old summertime."



A HEAD TABLET worn in Zuñi dances by women impersonating the Corn-maidens. (From an example in the American Museum)

ACCENT ON *HEADDRESS*

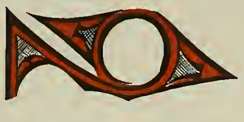
A brilliant array of tribal and ritualistic costumes are displayed at the ceremonials which the Indians hold each summer at various centers in the Southwest

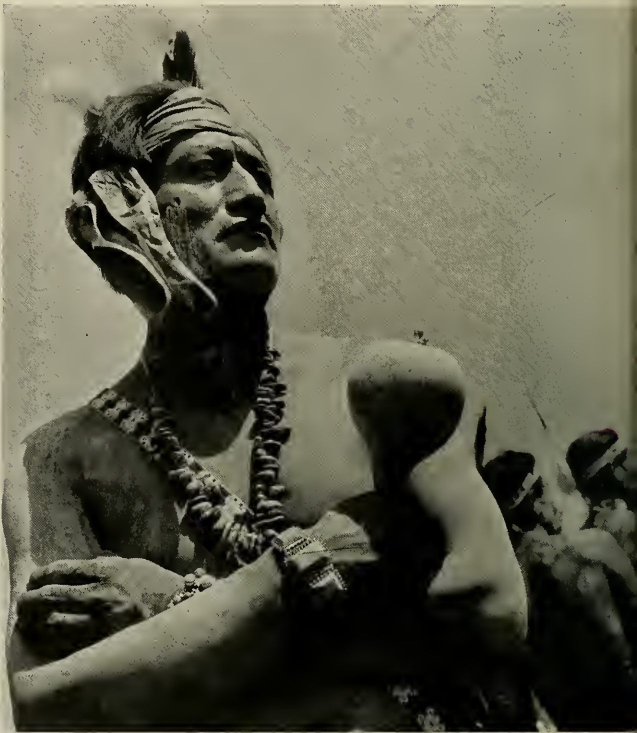
PHOTOGRAPHS BY ANDRE DE DIENES

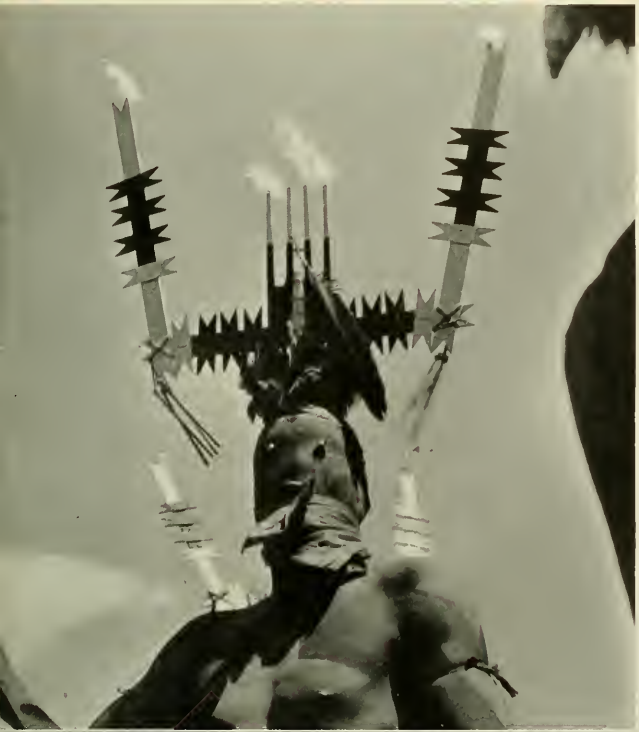
DRAWINGS BY ARTHUR H. OHLMAN

ZUÑI

THIS INDIAN with a gourd rattle and turquoise bracelet is from the New Mexican village of Zuñi, which is the sole remnant of a pueblo population of wholly distinct speech and unknown origin. Zuñi is the Southwest's largest pueblo. The greatest Zuñi ritual is the Shalako, named after a mythical tribesman of gigantic stature. *(Below)* A design from a woman's water jar

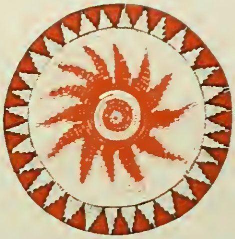


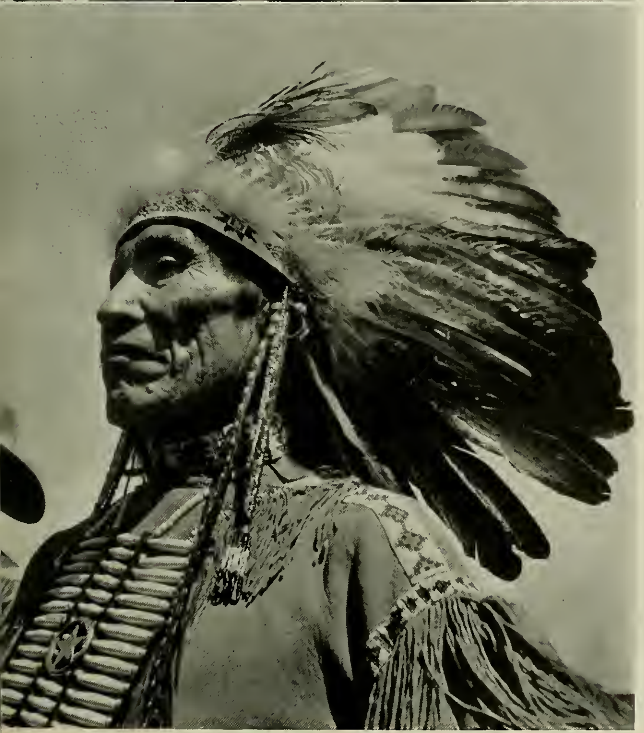




MESCALERO

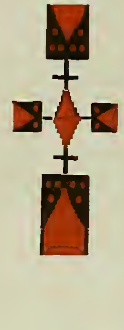
THE MAN at left is a devil dancer of the Mescalero Apaches, also of New Mexico. These Indians got their name from their use of the mescal, or century plant. They cook the trimmed stumps of the plant for two or three days in a pit and then dry the material and store it for future use. The design below is from a beaded tobacco bag and represents a wheel at a saw mill

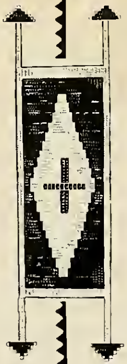




SIOUX

THE FEATHERED HEADDRESS has wrongly been made symbolic of all Indians. It was worn only by the Sioux, as at left. The Sioux occupied the Great Plains and lived largely on buffalo. The design below is an example of the beadwork of the Dakotas, a powerful tribe of the Sioux, who lived in what is now North and South Dakota. The personal decorations of their men were elaborate



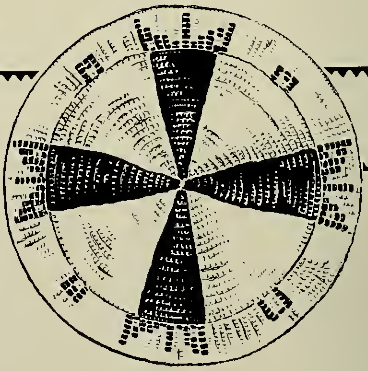


CHEYENNE

Quite like the Dakotas in costume and mode of life, the Cheyennes are chiefly interesting because of their migration from Minnesota to Colorado over a period of about two centuries. They now occupy reservations in southeastern Montana and Oklahoma. The girl at left is a native of Oklahoma. The design decorates the cover of a baby carrier in the American Museum, a wooden frame worn on the mother's back or hung on a saddle

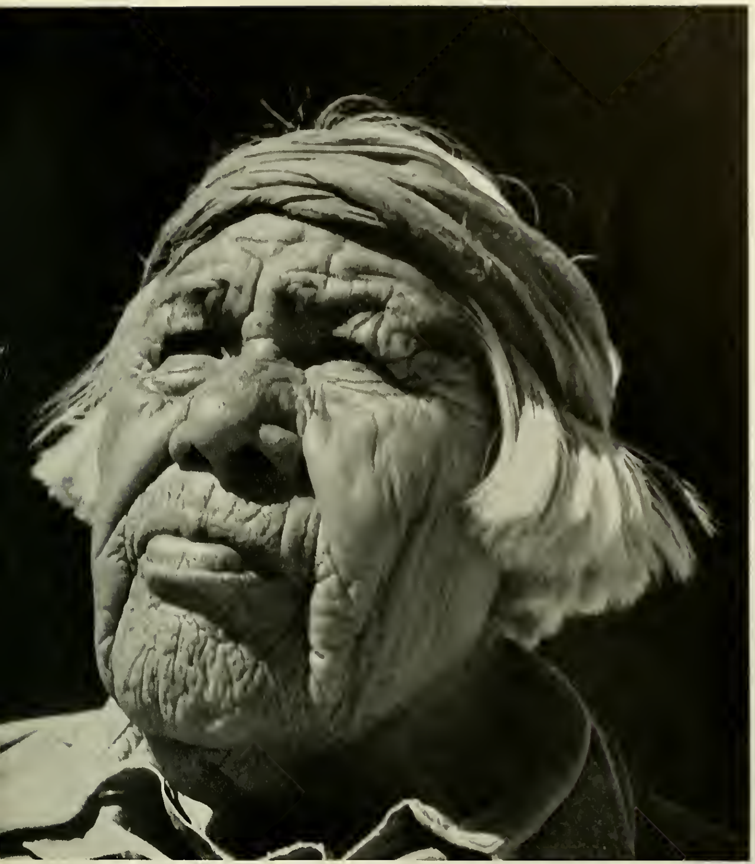
TAOS

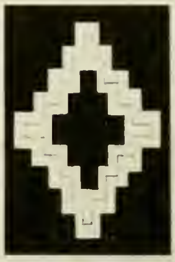
The Taos Indians are one of the northernmost pueblo groups inhabiting the headwaters of the Rio Grande in north-central New Mexico. These Indians are noted for their terraced buildings of sun-dried brick, with ladders communicating between the different levels. Modern Taos, from which the boy at left comes, is a popular art center. The design below is drawn from a bead decoration on a painted buffalo hide from Taos



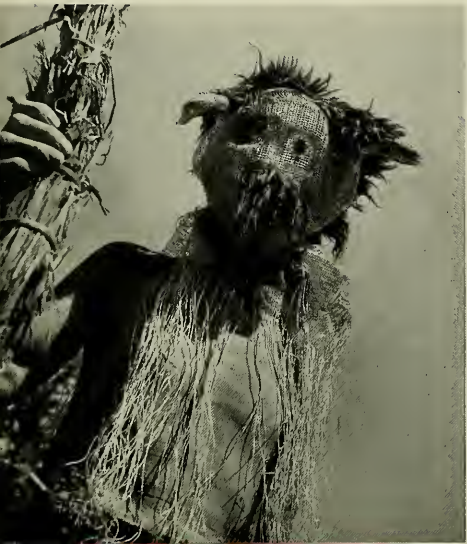
PICURIS

Only a few miles southwest of the Taos pueblo live the Picuris, another group of the artistic village dwellers of the upper Rio Grande. This pueblo region embraces two basic language groups and several well-marked dialects, but the Picuris and the Taos Indians speak the same dialect. Note the elaborate necklace worn by the Indian at left, an heirloom that would enhance any collection





NAVAHO



The navaho above, said to be more than 100, exhibits the cloth headband which his people characteristically wear in the most impressive colors. He could speak no English but was cordial and had no objection to having his picture taken. Ceremonial occasions require the Navaho to cast aside his simple but artistic daily garb and don a wide variety of weird costumes, such as that of the Mud Dancer at left. Though they were engaged in agriculture when first discovered, the Navahos have come to depend largely on flocks of sheep. They manufacture much of the wool into blankets which are sold for them by traders to tourists and others, who use them for rugs and house decorations. The design above is from a Navaho blanket of the "classic" type, with terraced patterns dominant

STRATEGIC METALS

NUMBER VI

ANTIMONY

In direct military applications, antimony eclipses all other strategic metals

By FREDERICK H. POUGH

Associate Curator (in charge),
Geology and Mineralogy,
The American Museum of Natural History

A REPORT on strategic minerals and metals published in 1925 said, "In general, antimony may be considered as a cheap metal that will become a substitute for expensive metals rather than be itself replaced." Yet today we find it high on the strategic list, and are casting about for substitutes for many of its uses; thus do predictions work out. However, our old sources of antimony had to be replaced by new ones several years before active participation in the war increased our problem. To a certain extent we can thank the Japanese, because their control of the trade routes rendered Chinese exports of antimony almost negligible. In about 1925, 90 per cent of the world's antimony came from China, but in 1940 only 15 per cent.

Stibnite crystals *(left)* from the classic—but now exhausted—Japanese deposit. Best known use of this many-purpose metal is in the hardening of lead for type and printer's slugs *(right)*

AMNH photo by Charles H. Coles

Antimony was known to the ancients, though not as a metal until about 1450. The origin of its name is uncertain, but a legend we would like to believe ascribes its derivation to a word meaning "anti-monk." According to this myth, one Basil Valentine observed that a dose given to hogs after "purging them heartily" resulted in an improvement in health and a fine fattening. Hence he thought that if it would do so much for hogs, what might it not do for monks? This experiment, alas, was less successful, for the monks died; and thus antimony got its name. The myth could be rationalized by attributing more resistant insides to the hogs, plus an "anti-monk" effect upon their internal parasites.

Antimony is still used in medicine, though the earlier exaggerated ideas of its value no longer hold. At one time it was so widely resorted to, with resultant bad effects, that laws were passed forbidding its use. At that time it was thought that mere contact with the metal was enough, and pills were kept available for use and re-use when the occasion warranted.

Antimony is sometimes found as a native metal, and some fine specimens have come from California. But all of the commercial production (except where it comes as a by-product) is from antimony sulphide or from an oxidized sulphide. The Latin name for antimony is *stibium,* and the mineral sulphide is known as stibnite. Stibnite is a common mineral, found in many lands and occurring in association with many other ore minerals. It is found near the surface, unlike the ores of tin and tungsten, which occur in deep-seated veins. Readers of earlier articles in this strategic metals series will recall that tin and tungsten ores were deposited by hot solutions not far from their original source in the once molten parent rock. They have been exposed only through eons of erosion and weathering. Stibnite and mercury ore (about which we shall speak later), are the exact opposite. They travel long distances from their igneous sources and are deposited near the surface where the waters have cooled sufficiently. This indicates where we must look for the ores. For tin and tungsten we must search in areas which are geologically ancient. But since antimony and mercury are formed near the surface, years of weathering would have long since removed them, so we must look in regions where igneous, perhaps volcanic, activity has been fairly recent. So literally true is this that we can find hot springs which today are depositing stibnite crystals as they cool and evaporate. Usually, geologically ancient regions will have low relief; geologically young regions will have sharp relief, and with recent igneous activity they may have volcanoes, lava flows, hot springs, and all the other phenomena of such eruptions.

Stibnite occurs in sharp brilliant crystals, steely in color and prismatic in shape. Stibnite crystals are rather variable in their development in different localities, and it is usually possible for an expert to tell the source of the specimen from its appearance alone, as is the case with many other minerals. Many widely distributed minerals reach the peak of crystal perfection at a single place: stibnite from the Island of Shikoku, Japan, is an outstanding example. But often this perfection is counterbalanced by limitation in quantity, and the Japanese mines are reported to have long since been exhausted.

Fine stibnite specimens have come from many other localities, the latest item for the collector being clusters of short but very brilliant crystals from Rumania. The crystals are often crooked, even though they are unbroken, for stibnite is the textbook illustration of a curious phenomenon in which a crystal can be made to glide, without breaking, along a plane at right angles to its length. Pressure applied to the middle of a crystal which is supported at both ends will develop a notch at that point and give the crystal, still structurally a unit, the lines of a swayback horse.

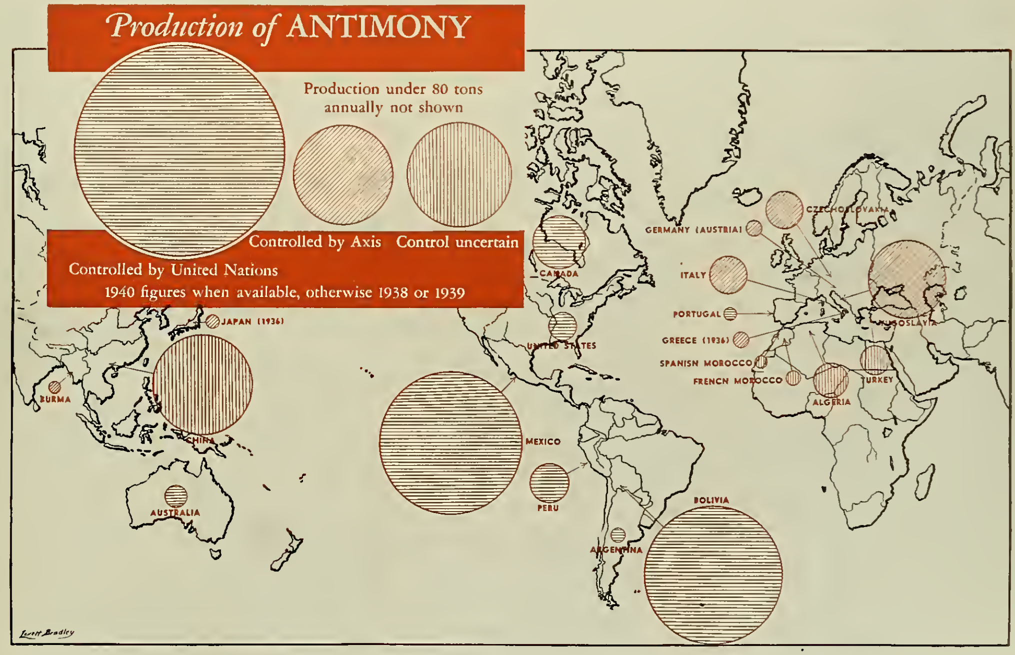
Although the sulphide is the primary ore, a very considerable proportion of our antimony today is derived from ores which, though once sulphides, no longer contain any sulphur.

Removal of the stibnite's sulphur through atmospheric weathering has produced much of the Mexican ore which is thus in the form of an oxide. When this happens the replacement is often molecule by molecule, with the result that the new oxide mineral preserves the form of the original sulphide crystals. Such chemical substitutions, known as pseudomorphs, in which an earlier crystal form is retained, are fairly common in nature. Many kinds have been described.

In addition to the primary ore of antimony and its oxide, there are a number of other ore minerals, such as silver, copper, and lead minerals, in which antimony is one of the constituents. Some antimony production results from the treatment of these ores, and some antimonial leads smelted from them are used in place of pure lead to which antimony has been added.

Antimony comes on the market in

Continued on page 55


Production of ANTIMONY
Production under 80 tons annually not shown
Controlled by Axis
Control uncertain
Controlled by United Nations
1940 figures when available, otherwise 1938 or 1939
CANADA
UNITED STATES
MEXICO
PERU
BOLIVIA
ARGENTINA
GERMANY (AUSTRIA)
CZECHOSLOVAKIA
ITALY
PORTUGAL
GREECE (1936)
SPANISN MOROCCO
FRENCN MOROCCO
ALGERIA
TURKEY
YUGOSLAVIA
JAPAN (1936)
CHINA
BURMA
AUSTRALIA
Everett Bradley

CROWNING GLORY of our northern swamplands: the showy lady's-slipper. Its clan *(Cypripedium)* includes many of our finest native orchids, but man has never succeeded in raising any of them from seed

Photo by F. H. Pough

Wild

By CARL T. RAMSEY

A FEW YEARS AGO one could see 15,000 showy lady's-slippers in one New Jersey bog. Today scarcely a vestige remains

Photo by C. T. Ramsey

ORCHID SANCTUARY

Commercial collectors have been methodically stripping the tropical forests of orchids for years, but how about our own orchids—55 species in the state of Vermont alone — which are being wantonly exterminated?

ORCHID lovers all over the world must tremble as they read the war news from Asia and the Pacific Islands. But long before the global war started, the wild orchid was rapidly vanishing from the face of the earth. The lumber, rubber, chicle, coffee, cocoa, and many other tropical enterprises one might mention have taken heavy toll of these rare and beautiful expressions of creative genius on our planet. The cleaning-up process that invariably precedes commercial ventures wrought havoc among the hosts of orchids which embellished primeval forest trees. The names of orchids which occur throughout Malaya, such as *Cypripedium, Dendrobium,* and *Vanda,* invoke joyful pictures that are now associated with destruction.

The enterprising Japs have been busy for over a score of years ripping the last *Phalaenopsis schilleriana* and *P. amabilis* from their arboreal environment. I have seen photographs showing carloads of these rare and beautiful orchids ready for shipment, some of them destined for the salesrooms of Europe and America. It would be interesting to know how many ever survived the journey. Nor are the Japs the sole perpetrators of vandalism. What is one to think when a well-known orchid establishment in Europe sends out its collector to locate the only known hillside where *Cypripedium spicerianum* is found, to make a final collection and then to destroy the station completely by fire to raise the price of the remnants? It is a long, sad story, for the economic factors that determine man's destiny cannot be interfered with for the sake of a mere handful of orchids. No one can tell how many endemic species of orchids were lost when the Panama Canal was dug. Nor can we estimate the orchids' disappearance in the increase of coffee plantations, the oil industry, and other commercial projects that are daily making their inroads in the tropics.

Fortunately the science of growing orchid seedlings and the vogue of creating large hybrids, plus quarantine laws, have put a check on vandalism in the collecting of wild orchids, in some quarters. Nevertheless, the work of destruction is progressing steadily. In the olden days it was customary to secure a lease and then fell many acres of grand forest trees to gather the spoil. Now that a method of raising orchids from seeds in agar flasks has been perfected and many of the more easily grown commercial varieties are established in greenhouses, the wild orchid has had a temporary lease on life. But the whole problem remains one of international consideration. The grower always wants new stock for the breeding of "bigger and better" orchids, so there should be regulations to protect certain rare wild species.

Few flower lovers realize the high degree of specialization which exists in the hundreds of orchid genera. Orchids are globetrotters, and this is doubtless responsible for the delicate adjustment in root, stalk, and flower structure. These aristocrats of the bog, mountainside, and tropical jungle-treetops have become dependent on special combinations of soil, climate, and other factors, which are difficult even for the specialist to duplicate. The inseparable association of certain fungi with their roots alone makes the problem of orchid-growing virtually an impossibility for the amateur. This is strikingly illustrated in our native terrestrial genus *Cypripedium,* or lady's-slipper. Not only do they have to have the association of lime or acid in the soil, but factors of light, shade, and moisture are subtle in determining their well-being. A distinct cleavage exists between the lime and acid soil types.

Up to date it has been impossible to grow the American wild lady's-slipper artificially beyond the protocorm stage. Time and again I have seen well-meaning people wanting to transplant the lady's-slipper from its native haunts to their stiff garden soil.

THE PINK LADY'S-SLIPPER thrives in evergreen groves and on dry slopes—if man does not deny its right to live

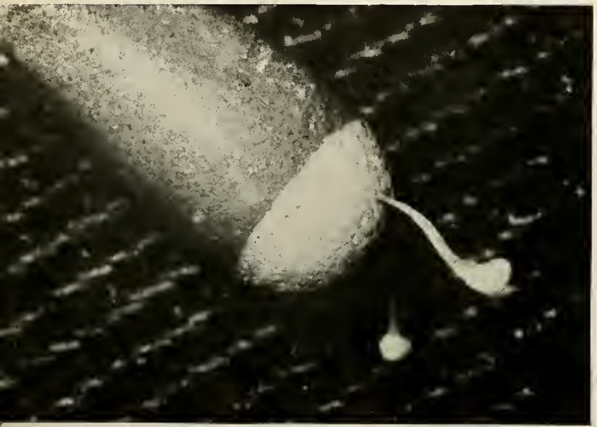
THE RARE WHITE LADY'S-SLIPPER is among our daintiest; care could preserve it, from New York to Minnesota

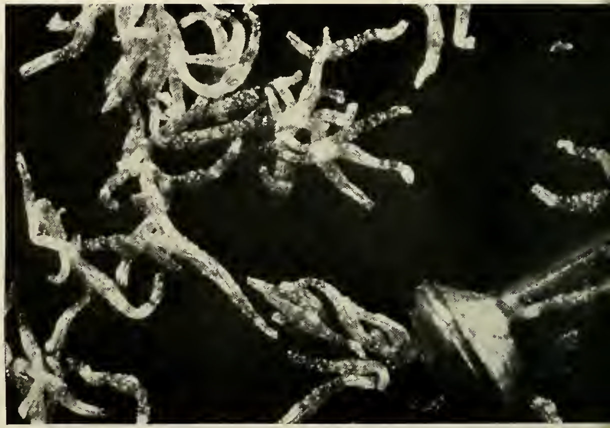
Photos by C. T. Ramsey

Photo by C. T. Ramsey

(*Above*) Elegance and grace mark the yellow lady's-slippers. rising on tall stalks from wide leafy bases

A closer view shows the balloon-like lips, burnished gold in color and smoothly rounded as if ready to burst





Photos by F. H. Pough

Small in comparison with a match head, the pollen masses of the yellow-fringed orchid contain the fertilizing element for many thousand tiny seeds

Hair-like seeds of the pink lady's-slipper. Man has failed to grow them, but with Nature's mysterious care they develop into glorious plants. Note pinhead

Photo by C. T. Ramsey

Beautiful *vanda caerulea* of the East. One collector delivers 1000 plants each Christmas, to sell at eight cents each. Thus the forests lose them to the ash can

Photos by F. H. Pough

(*Right*) A perfect specimen of *Cypripedium fairicanum*

This is a natural instinct, for we all are worshippers of beauty. Alas, such attempts invariably prove fatal. We have had sporadic wild flower conservation propaganda in the public schools, and doubtless some good has accrued. Maybe it is the elders who need admonition and education more than our youth. Every country outing during the blooming period of the lady's-slippers produces casualties. They are an exciting sight. Indeed it can readily be understood how in earlier days this excitement was translated into the superstition that the roots of these plants were useful as medicine. To see the showy lady's slipper in its native haunt is indeed a panacea. But to see these same plants massed together by the hundreds as if they were in a concentration camp is enough to make any flower lover sick.

If the evidence of the last score of years in Vermont is any criterion, anyone can predict the ultimate fate of the *Cypripedium reginae* in these environs. In the score or more places where one could see from a dozen to hundreds of these handsome plants, not a vestige of their glory is to be found today.

Fortunately many of our wild orchids are inconspicuous and live in secluded spots where few excursionists ever venture. But even these are threatened with extinction by the cutting of timber, the inroads of agriculture, the commercial sphagnum or peat moss traffic, and the draining and filling in of bogs as a result of the encroachment of civilization about metropolitan areas and rural communities.

It was this swan song of the orchid that took us from New York to Vermont eight years ago. I had been experimenting with the terrestrial wild orchid for a long time prior to this. My experiments have continued for about a score of years. Initially I had intended to grow wild orchid seedlings to offset the rapid decimation.

The casual observer, peeping into "Swampacres" at Dorset, might see little to pique his curiosity at certain times of the year. It is in truth a bogland nestling among the alders, willows, larches, maples and snowy birches, a half mile from the highway. Here embowered in wild tranquillity, with the hilltops encircling the horizon, we found an ideal sanctuary for wild birds and native orchids. Geologically the Dorset Valley is included in the great marble basin extending from New York Bay to the St. Lawrence. In the middle of the valley where we are situated, there is a happy combination of lime and acid soil, for which the glacier is responsible. The adjoining hillsides are practically all outcroppings of limestone, while from farther north the ice sheet gathered acid debris and dumped it in our valley in a series of acid drumlins or moraine mounds. This produced an ideal situation for the various types of orchids at "Swampacres." Indeed, it would be difficult to find a place better suited for an outdoor laboratory in what is probably the first experiment of its kind in this country. Flower lovers may express surprise when told that over 55 species of orchids grow wild in the State of Vermont; and over two-thirds of these occur within the confines of our eight-acre sanctuary.

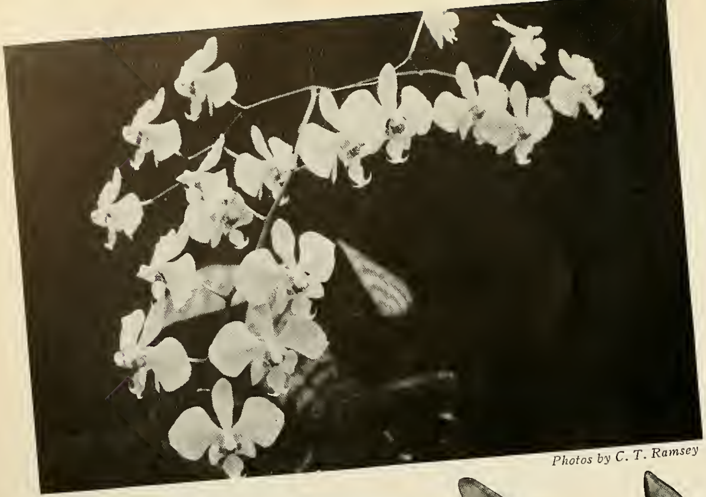
Animal enemies

Before the various species of orchids could be accommodated, "Swampacres" had to undergo a heroic process of renovation. Moreover, I soon discovered that I had local enemies, such as the mole, rabbit, skunk, and woodchuck, which developed into serious offenders. My concern was not so much for the native species—they could be replaced—but for those imported for observation and study from Europe, Asia, Canada, Alaska, California, Mexico, and

One of the "butterfly orchids" (genus *Oncidium*). This group comes from tropical America and is well known for its bright attractive colors and peculiar form

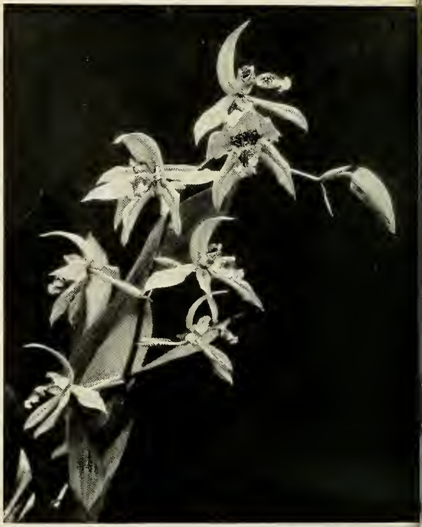
Photos by F. H. Pough

An exotic hybrid, of the sort greenhouse-growers raise readily from seed. Conservationists have had little success with our dwindling native orchids

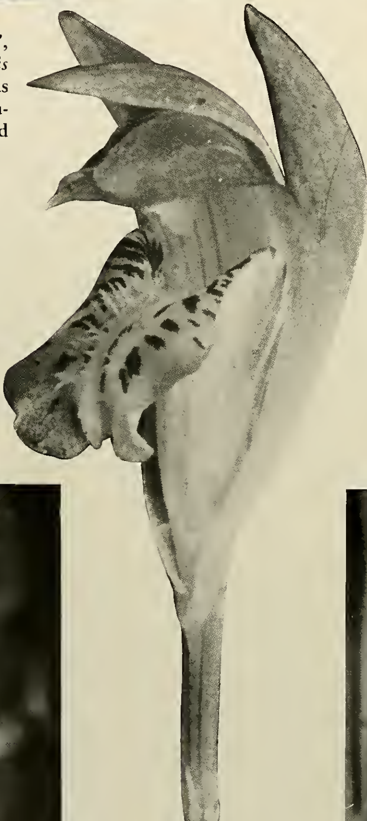


Photos by C. T. Ramsey

Meaning literally "moth-like", the genus of which *Phalaenopsis schilleriana* is a member contains some of the showiest and most beautiful of all spray orchids. (India and Malaya)



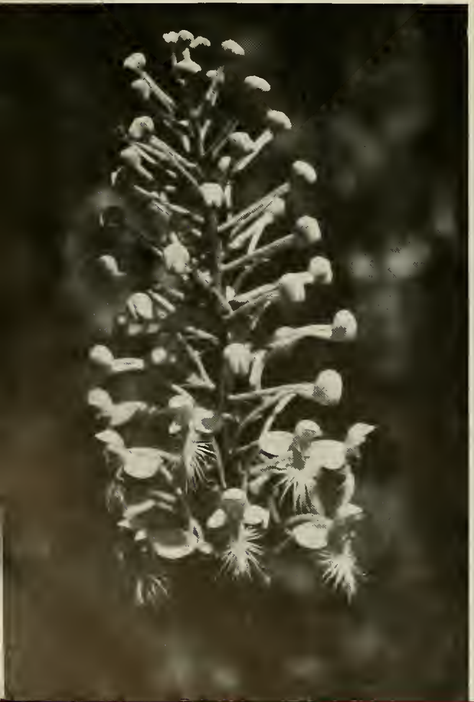
The green orchid from Borneo, *Coelogyne pandurata,* is one of the handsomest of its tree-dwelling clan



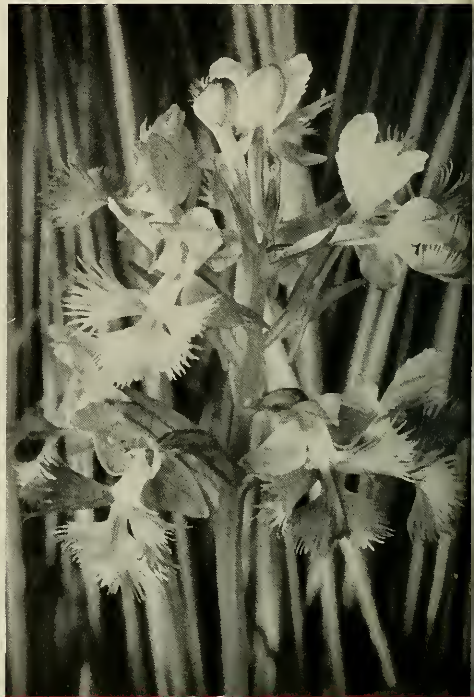
Photos by
F. H. Pough

(*Above*) Japan has its only cousin. Let us preserve the beautiful dragon's mouth (*Arethusa bulbosa*)

The showiest orange-colored orchid native to our northern territory: the yellow-fringed orchid *(below)*



(*Below*) A giant sometimes five feet high, the large purple-fringed orchid is the biggest of its group



Japan. It was trying indeed to find a newly introduced species dug up by some curious skunk the morning after I had planted it. And in spite of the soil advantages, it was necessary to shift the plants to different quarters of the bog in a process of trial and error. In many cases I failed to know the proper requirements, and this lack of knowledge invariably resulted in the death of the plant. The problem of protection from rodents was solved by the use of three-eighth-inch wire mesh baskets, which could be easily packed and repacked and placed according to the requirements of light and moisture.

A score of years of experimentation with wild orchid plants has convinced me of a few very definite things. While I have been successful in observing and recording necessary information in pursuance of my studies of the form and structure of orchids, the project for conserving anything but the native species may be set down as a failure. With few exceptions imported plants linger with peevishness for one, two, or even a dozen years, but they show no degree of vigor or inclination to flower. Apparently it is impossible to supply certain imported orchids with the necessary environmental conditions. I might mention some of these as they behaved at "Swampacres." The California lady's-slippers *Cypripedium californicum* and *C. fasciculatum* flowered for the first year, and *C. montanum* bloomed two years. From that time on they merely produced feeble shoots devoid of bloom. Obviously the climate of Vermont is too harsh for them. So too, Japanese lady's-slippers *(C. japonicum, C. debile,* and *C. macranthum)* flowered two years and from that time appeared only anemically. The rare white lady's-slipper, *C. candidum,* which came from a New Jersey bog, has flourished somewhat better. For over fifteen years this charming orchid has been producing flowers, and the crown which originally had but four shoots, has now increased to fifteen.

The most lamentable feature of importation, say from California, is the amputation of roots, ostensibly to save postage. I have seen a crown of plants having nine to a dozen leads, with roots clipped to between six and nine inches to fit a box 5 x 11 x 6 inches deep, with packing material taking up at least a third of the space. Normally the crater which such a plant would occupy would be at least from five to six feet in diameter and about eighteen inches deep. *C. montanum* is a deciduous orchid, and the energy of previous years is of necessity stored in the roots. As I unpacked the box, my thoughts flew to the Sierras by a lake shore where the air was heavy with white azalea bloom and where hard by grew just such a plant, mingling its own delightful scent. The plant in question I venture to say, was at least 100 or more years old and it sold for the ridiculous price of five dollars.

Vanda and vandalism

The horticultural hybrid with its Asiatic forebears has won for itself high place in commercial markets and public demand. It is the rare wild varieties that need conservation. Not so long ago I talked with a collector who had been in India and Burma on a special mission to collect certain wild species. His tale of *Vanda caerulea* was revealing. Who would compare any horticultural hybrid with so lovely a wild species as *V. caerulea?* Like our showy lady's-slipper, *V. caerulea* in Asia is approaching extinction. Strangely enough, many of these wild rarities have had superficial attention among conservationists. It is now necessary, however, for collectors to have a permit before they can go into the Burmese forests. *Cypripedium insigne* cannot be collected at all, but *V. caerulea,* which blooms in the fall of the year, commands a ready market in Calcutta and other centers where the flowers are sought by foreigners. One local native has a standing contract to deliver a thousand or more *V. caerulea* plants each Christmas. These plants are sold for eight cents each. After the holidays when they have flowered, their destiny is the foreigners' ash heap or garbage can. Normally these plants sell in the United States for from seven to ten dollars a plant.

In America there is a crying need for a few wild orchid sanctuaries. To my knowledge this matter has had little or no attention. It would be comparatively easy to acquire certain areas where the showy lady's-slipper, *Calypso,* and certain of the *Habenaria,* such as the white-fringed and large purple-fringed orchids, are growing wild. These sanctuaries would automatically afford ideal haunts for the woodcock, certain warblers, and other birds that are associated with swampy country.

I know of glaring cases of ruthlessness in New Jersey and Vermont, indeed also in other parts of the country. I recall one bog in New Jersey where it was possible to see between 15,000 and 20,000 showy lady's-slippers each June. In the two-score years that I have known this bog, the pageant of *C. reginae* has dwindled annually until today there is little or nothing left of it. Apparently there is nothing to be done about it; such beauty simply cannot survive. The peat moss traffic, the nerve medicine business, and countless other encroachments form a juggernaut of destruction that no mere flower lover can stop. What is one to think of a prominent nurseryman who sends out half a dozen men in a truck to gather white-fringed orchids in two-bushel bags as if they were tubers of a common potato? When the woman who owned the property wanted to know what the nurseryman was doing, he pertly announced that it was none of her business. This same firm offered to buy showy lady's-slipper plants at two dollars a hundred. At a retail price of twenty-five or fifty cents each, one can easily figure the net income of such an enterprise. The age of these plants ranges anywhere from twenty-five years to a century or more. It should be repeated that up to the present science has not been able to produce these wildlings in the agar flask, so that the decimation will continue until some drastic measures or an educational sanity will put a stop to it.

We are going to discover the real significance of orchids someday. Meanwhile, what are we going to do about it? It is a desperate situation that will need more than a few effete laws of protection. The work of systematic botanists is still progressing, but we know comparatively little of the natural history of these fascinating flowers, and the mummies in the herbarium sheets deserve more than a mere label. Their living presence in a wild bog is a precious

Continued on page 56

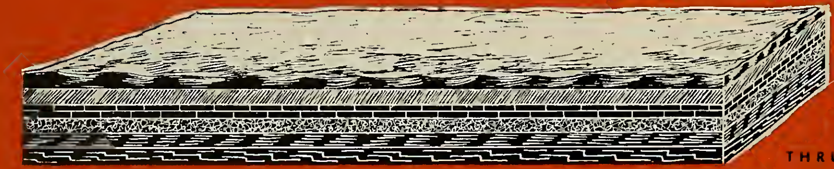
HOW CHIEF MOUNT

By H. E. VOKES
Assistant Curator of Invertebrate Paleontology
American Museum of Natural History

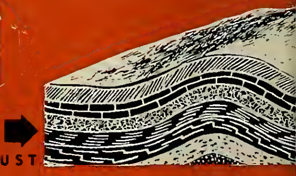
CHIEF MOUNTAIN, known to the Indians as "The Old Chief," rises to 9000 feet above sea level. Viewed from the west it appears as a block of ancient limestone 1500 feet thick, on the border of Glacier National Park

Barnum Brown photo

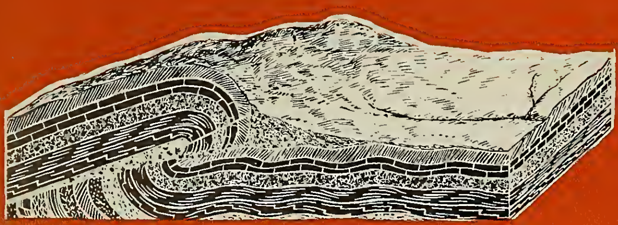
DRAWINGS BY JOHN BOWEN



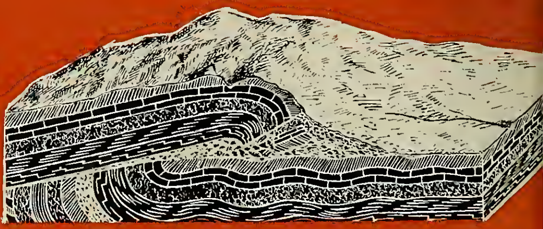
1 First, flat beds of limestone and shale were formed under a shallow sea



2 —700 million years, la



4 The beds to the west slid up and over those to the east



5 —sandwiching younger layers of rock between older ones

IN WAS MADE

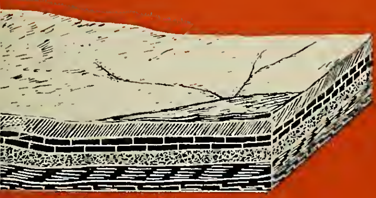
The extraordinary story of a mountain that was pushed uphill and after millions of years became the sentinel of the red man's hunting grounds

PROUDLY, square and strong like a great warrior, "The Old Chief" stands forth in massive grandeur overlooking more than 100 miles of plain to the east. You have traveled over the prairie as on a great sea, westward over the plains of Montana toward the Lewis Range of Glacier National Park, when this landmark looms up ahead, a large lonely bastion guarding the even more gigantic wall behind.

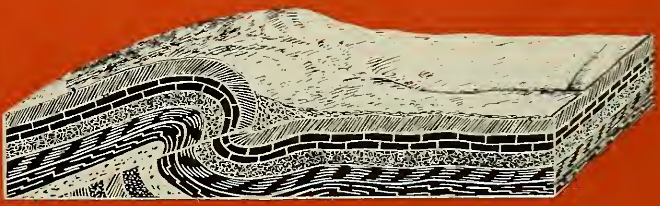
Some twenty-odd years ago there was a great earthquake in central China. The jarring motion of the quake caused great cliffs of wind-blown sand (loess) to break loose. Devastating avalanches swept over hundreds of tiny villages, burying more than 100,000 helpless villagers. Ever since, this region has been known to the Chinese as "the land where the mountains walked." Chief Mountain (as we of today have modified its ancient Indian name) did not walk to its present position—it was pushed! And it was pushed uphill! For Chief Mountain is no ordinary mountain; it is unusual in its present position, in its nature, in its structure, and in the history of its origin and development.

Events of two widely separated periods in geologic history are recorded in the rocks exposed in Chief Mountain.

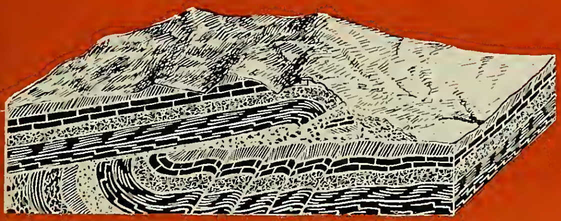
The oldest layers were deposited hundreds of millions of years ago—how many, we do not know exactly, but 700 to 800 million seems to be a safe assumption. During those most ancient days shallow seas covered the region that we now know as Mon-



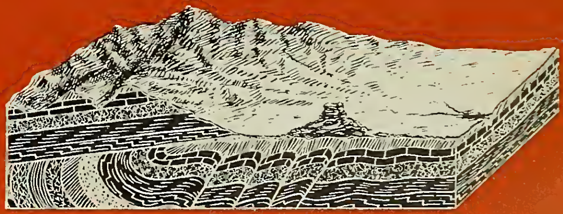
at pressure folded them



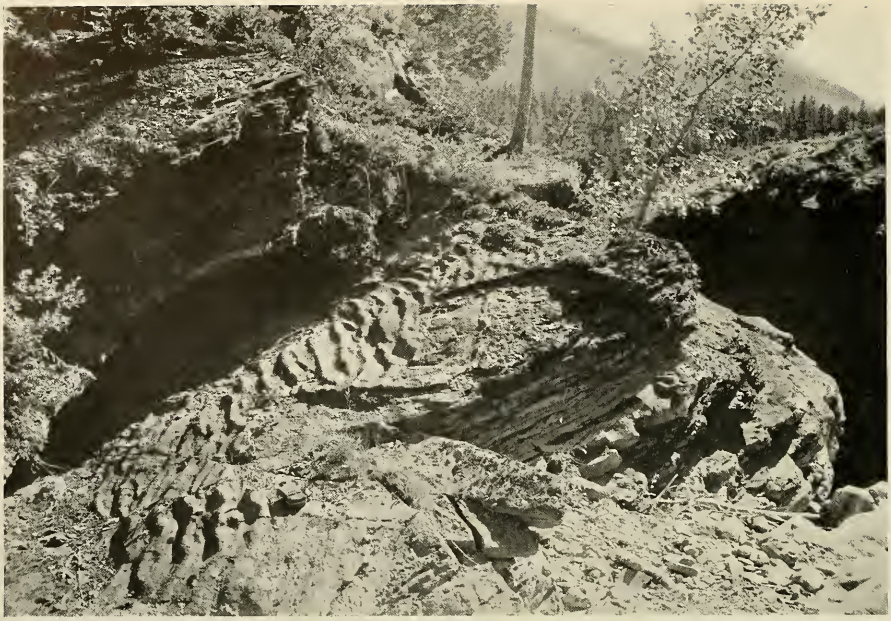
3 Instead of crumbling, the limestone resisted, and the layers broke



6 Eight miles of rock were pushed at least 15 miles

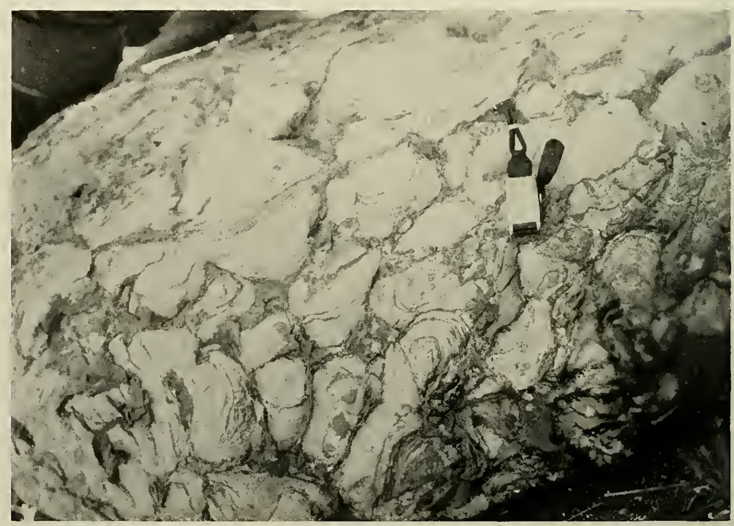


7 Then ice carved away all but one block—Chief Mountain



R. T. Bird photo

Ripple marks visible today in the sandstone of Chief Mountain *(above)* tell that these ancient rocks were laid down in a shallow sea



Lime-secreting seaweed of a type now extinct formed the limestone block at right, a type readily recognizable to anyone who visits this landmark and examines the evidence of its strange history

Photo by the author

tana and adjacent parts of Alberta. This was in those very early times when animals were either rare or had not as yet learned to build shells or other hard parts that might be preserved as fossils. But plant life was abundant; the sea bottoms were covered with masses of strange lime-secreting seaweeds whose remains built up great thicknesses of limestone. These limestones alternate with beds of shale that are characteristically ripple-marked and mud-cracked, showing that they were all deposited in a shallow sea. After many, many years the sea withdrew, leaving behind it a series of these limestones and shales which are seven to eight miles thick!

During the ensuing interval of about 700 million years, deposits were probably laid down, but now they either are buried under younger beds or have been eroded away.

The record is picked up again about 80 million years ago. The rocks laid down then consist of sands and muds deposited in a sea in which animal life was abundant. These were the seas in which roamed the ammonites with their chambered shells, while on the shores the equally bizarre dinosaurs dominated and terrorized the tiny ancestral mammals.

But this sea was short-lived in comparison with that older one. For it was forced to withdraw as the land commenced to groan in the pangs of the birth of a great mountain area. The first Rocky Mountains were beginning to develop. Tremendous pressures began to compress and squeeze the strata. The evidence shows that these pressures were exerted from the west, squeezing the beds against the great rock mass which underlies the Great Plains. In many places the beds crumpled, forming highly folded mountains. In western Montana, the thick limestones were strong and resisted the squeezing for a long time, but finally the pressures became too great. Instead of crumpling, the strata broke, the beds to the west sliding up and over those to the east. The entire seven or eight miles of limestone and shale were pushed not only up and over the same beds to the east of the break but also over all the sandstones and shales of the younger series.

Just how far they were pushed we do not know, but we can see that it was at least fifteen miles. And when they finally came to rest there was a belt of land at least fifteen miles wide and almost 100 miles long in which the rock sequence included not only the normal succession of older beds overlain by younger, but also younger beds in turn overridden by older ones—a gigantic sandwich of thick limestones with a filling of sandstones and shales.

But erosion soon began to gnaw away at the sandwich, eating the uppermost crust first. Rivers developed canyons across its surface, deeply dissecting it. And then, about a million years ago the climate became colder, glaciers formed on the higher elevations and began to move down the valleys, deepening and widening them as they went. As it became colder and colder, the glaciers moved farther down the valleys and out onto the plains, where they joined the great ice sheet which was moving down across the plains from northern Canada.

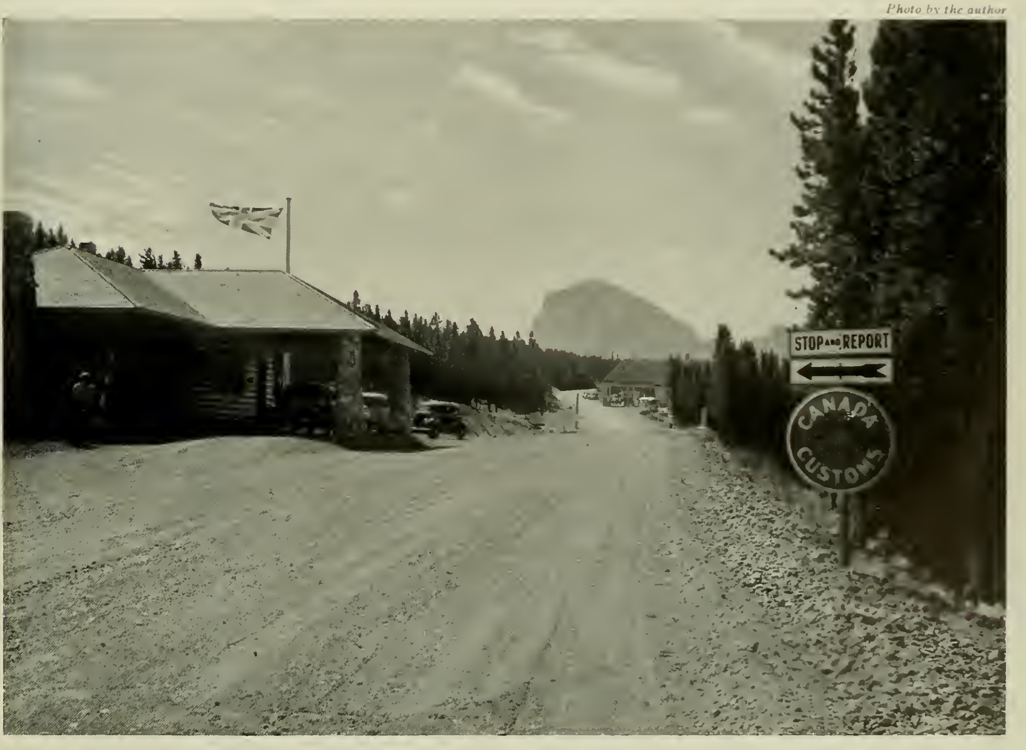
When a warm climate returned and the ice melted, the upper layer of the rock sandwich had been deeply carved. Thus was formed the glorious scenery of Glacier National Park. Near the edge the crust had been completely cut through to the filling of younger sediments. At one place, however, a great block of the older limestones stood forth on the plains, completely separated from the main mass behind. This block is today called Chief Mountain.

Chief Mountain is indeed no ordinary mountain. Rising more than 9000 feet above sea level it is a single block of ancient limestone, 1500 feet thick, sitting on a series of younger sandstones and shales, over which it has been thrust from a place far to the west where the limestones were originally laid down.

A square, towering monument to the forces within the earth which made it, the Old Chief stands, facing the plains, an imposing sentinel still guarding the hunting grounds of the red men who gave him his name.

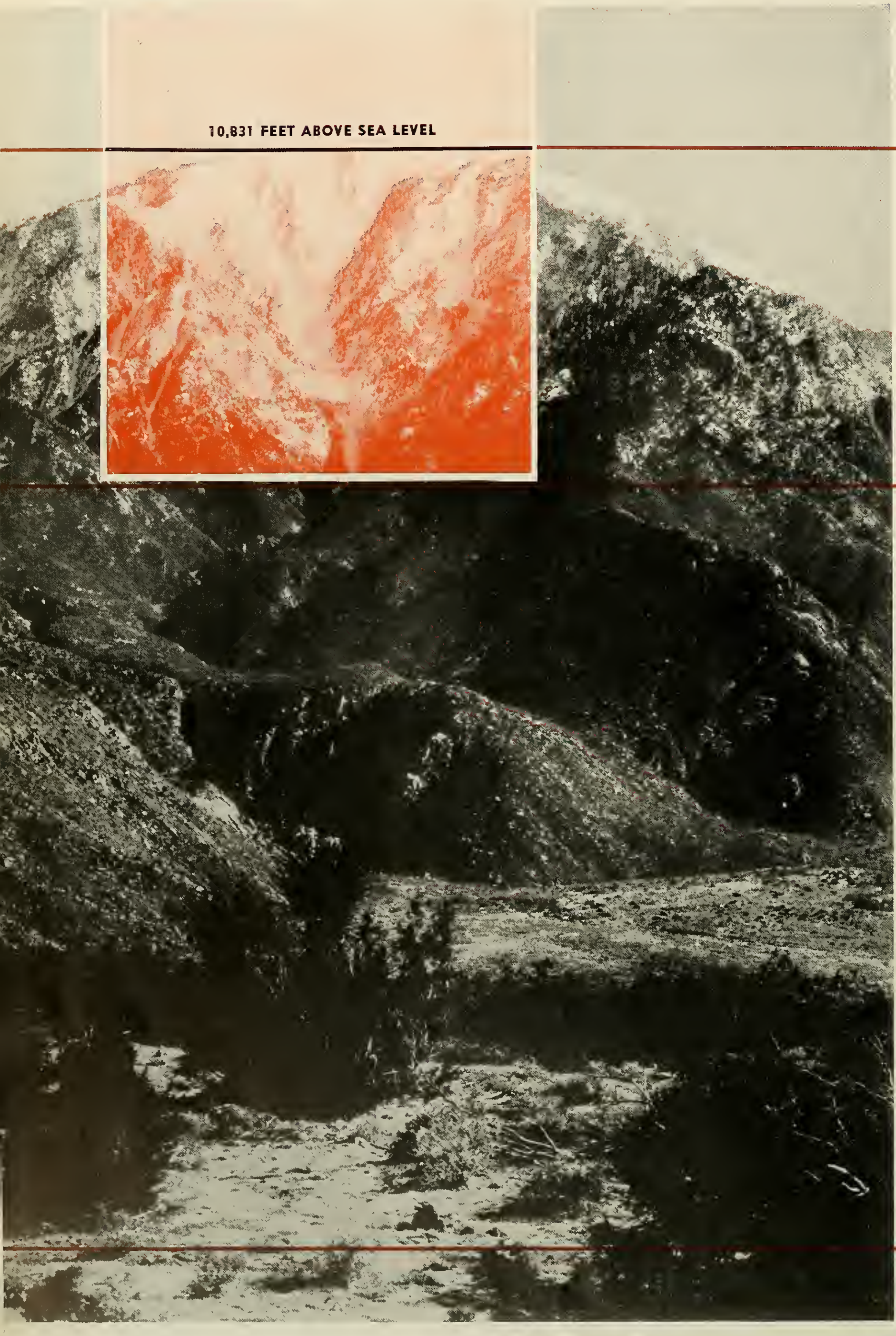
LIKE A PROMONTORY on the sea. Chief Mountain is a landmark to the traveler traversing the broad plains east of the Rockies in northern Montana—a sentinel over the most peaceful border in the world

Photo by the author



SAN JACINTO—Our Greatest

ALL PHOTOS BY HAMELIN



10,831 FEET ABOVE SEA LEVEL

OVER 6000 FEET ABOVE
LOWEST REACH OF SNOW
IN PICTURE

4500 FEET
ABOVE SEA LEVEL

DESERT FLOOR—
1200 FEET ABOVE SEA LEVEL

Precipice

By TOM HUGHES

SNOW CREEK plunges to a thousand destructions down a precipice whose towering grandeur the upraised camera can scarcely encompass. The eastern of the three brooks forming it has been called the wildest stream in North America

THE sheared-off and gouged-out north face of Mt. San Jacinto presents the greatest precipice in the nation. No other of our cliffs approaches its skyward reach. When the desert air is especially clear, the beholder half expects the far cornice to begin toppling over.

The precipice rises alongside highway 60-70-99, 100 miles east of Los Angeles and ten miles west of Palm Springs.

For the naturalist, San Jacinto is unique among districts in the United States, perhaps in the world. Five, if not six, life zones are exhibited on the mountain. These, using the Western classification, range from fan palm of Lower Sonoran to Hudsonian limber pine. Some authorities consider the summit as penetrating the Arctic-Alpine, thus making San Jacinto the southernmost mountain in the United States to exhibit this zone. Theory aside, there is an ancient limber pine reaching out toward the very topmost boulder.

Our great north scarp, however, offers meager evidence of the upper zones. A squat, tapered-bole cedar clings here and there while, deep in a chasm, some névé pocket may be fringed with little asters that recall the edelweiss. You could traverse the scarp all day long and meet no animal inhabitant. In the nighttime you might hear the scuttle of a lizard among the pebbles, and dawn might disclose an eagle wheeling high. Other birds have little call to visit the rocky desolation, even in passage, and none but flying fish could navigate the upper cataracts of Snow Creek.

This stream, of three confluent head brooks, gathers somewhere in the higher walls, sinks in its granite bed, gushes out, and hurls itself to a thousand destructions down the precipice. Geographers have called its east fork the wildest stream in North America.

In all our panoramic land there can be no vaster view than the one from atop this monument. A rim of ocean, the gaunt Panamints of Death Valley, a snowy peak in Nevada. Off toward Old Mexico a turquoise sparkles on the breast of the desert—remnant of an ancient dried-up sea, it still offers its cup of water to the sun.

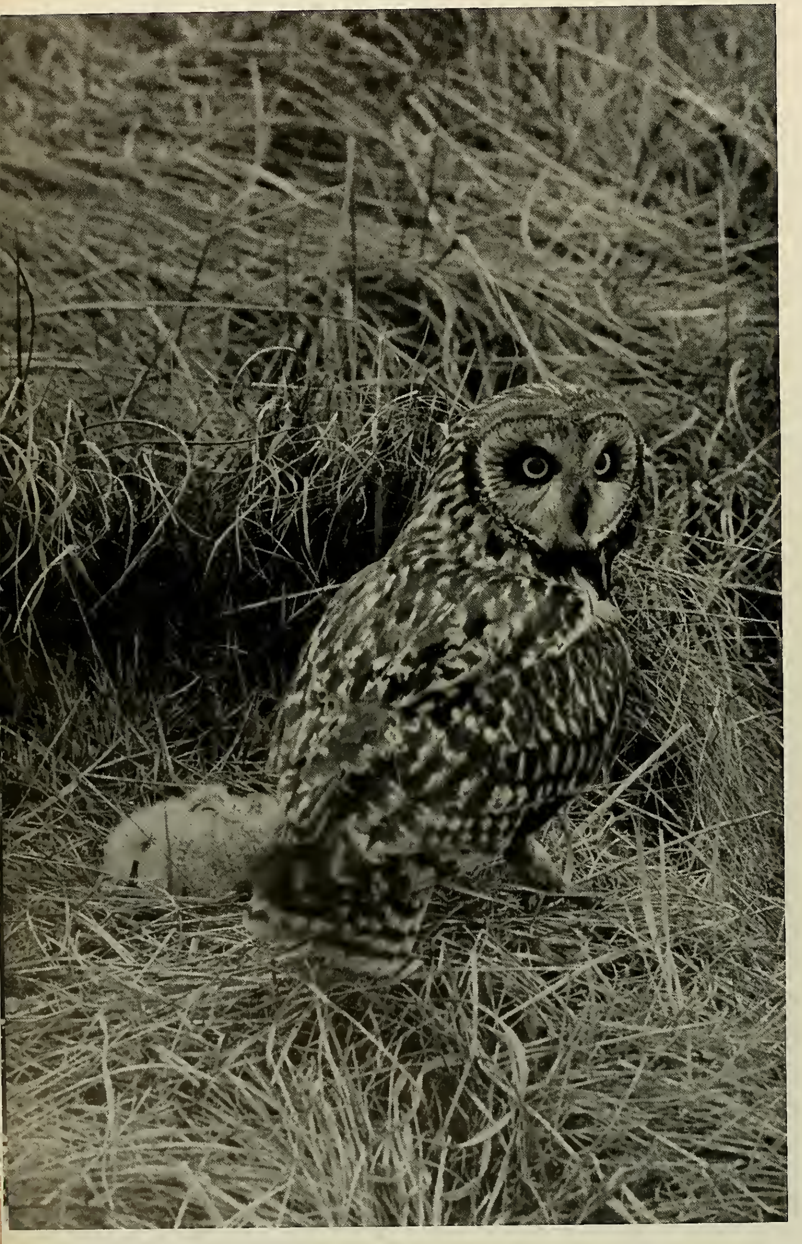
Gradually you gather courage to look down. Taking a firm hold, you peer over the brink. Everything appears to have slid away. A mile below, in a haze of twilight, you make out the granite debris, and pinnacles that somehow stood against the debacle; but their foundations are lost to view in the purple shadows of the desert floor, still another mile down. Language fails now. One word that may come, on the wind that rises out of the abyss, is "cataclysmic."

You may toss a stone over; but you will see nothing, hear nothing. No echo comes up from the void.

So stands the peak of Saint Hyacinth, first in abrupt height, first in architectural *élan,* and first in those qualities that fire the mountain lover's heart with ecstasy.

The short-eared OWL

The high, windswept moors of the Scottish borderland are the scene of a photographic expedition to study the rarest of the owls that breed in the British Isles



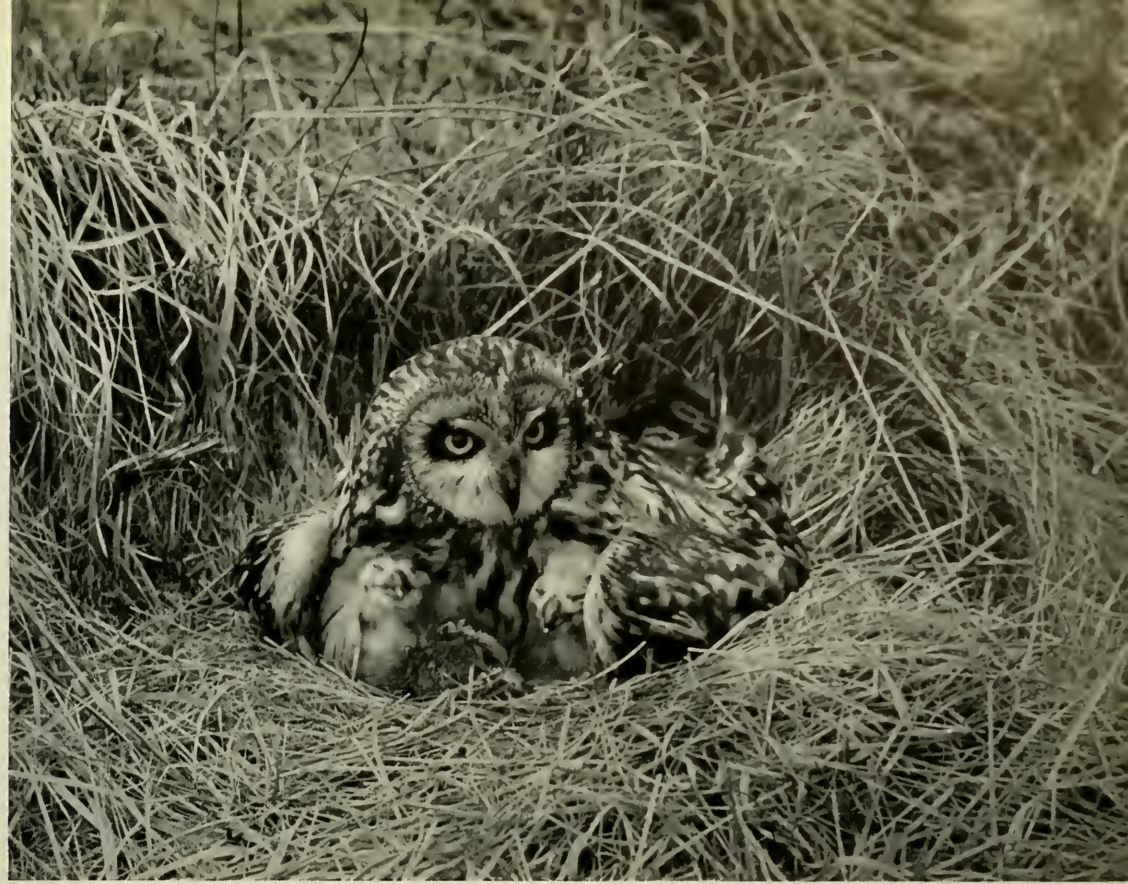
By G. K. YEATES

ALL PHOTOS BY THE AUTHOR
FROM LEONHARDT

APRIL today has given of her best. The showers, the forbidding skies, which even when most promising had yet always threatened, and above all the wind, have been absent. The elements indeed have striven, for a brief period at least, to give real meaning to Browning's much quoted words about the joys of an English April. Today, for the first time since we invaded their lonely solitude, the Border moors have smiled, and the burns and cascades glistened in the sunshine beneath a cloudless sky. The dried dead moorland grass that has hitherto been lashed level with the ground by the fury of the wind, and the scattered pine clumps that have swayed restless before its force, have both alike been at peace, without a rustle. All day the curlews have greeted the new promise with the lovely music of their breeding trill, and the golden plovers in less elaborate display have piped their satisfaction at the change that at long last has brought spring to their moorland home. This evening the blackcocks have sparred with more than usual determination, as well they might, for has not today brought to their tourney-ground the first gray hen of the year?

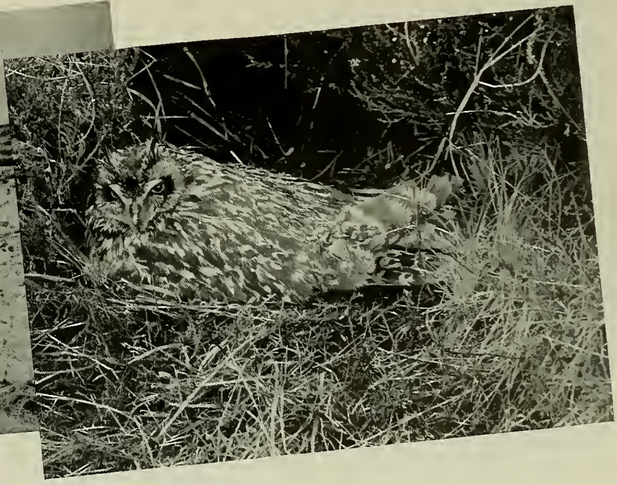
The voles in the deep grasses have everywhere scampered away as we disturbed their runs. And after the voles have come the short-eared owls *(Asio f. flammeus)*. Yesterday, a day of wind and rain, few living things had moved. The moors seemed dead and not a lit-

(Left) A MERE EIGHT FEET from the camera and unafraid. Unlike most owls, this nearly cosmopolitan bird is active in daytime as well as at night



The photographer's hide *(below)* overlooks the moorland home of the short-eared owl. Where voles, or meadow mice, abound, this avian expert quarters the ground with a graceful buoyancy unrivaled by any of its kind. In years when voles are scarce, the owl is equally so

(Above) **Pushing** their way to light from the comfort of mother's wings. When preening, re-arranging, and feeding her young, Mother Owl's head seems detached and capable of turning in a full circle. *(Below)* When angry or alarmed, Mother Owl shows her ear tufts

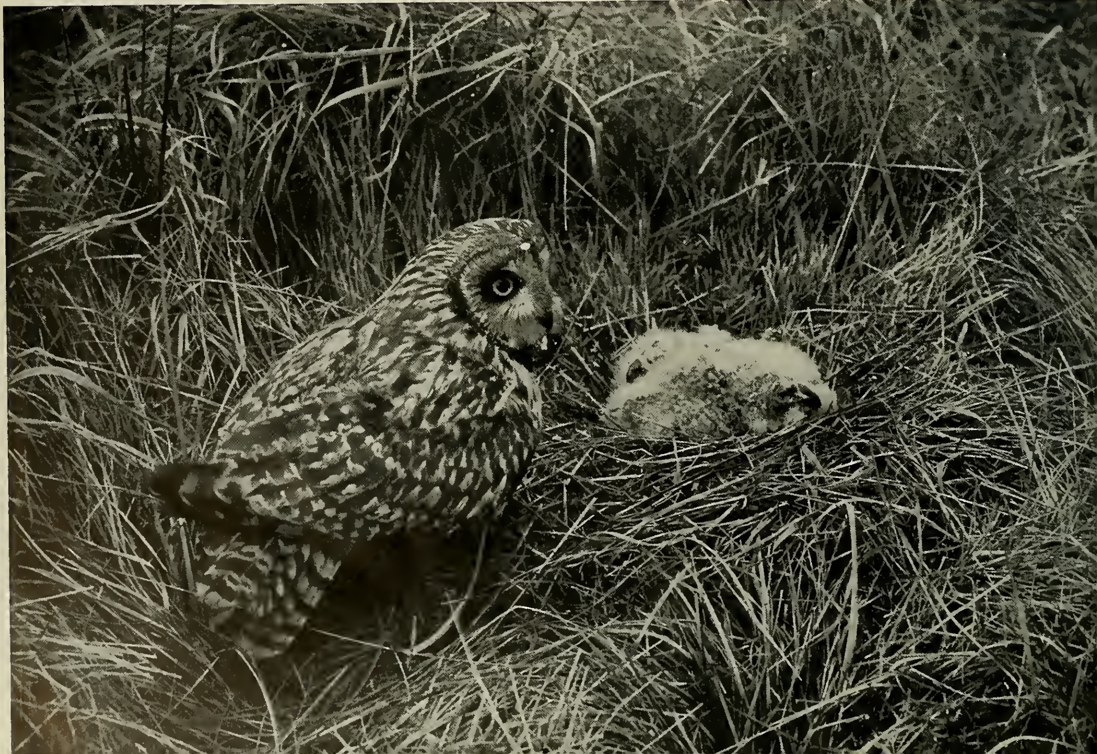


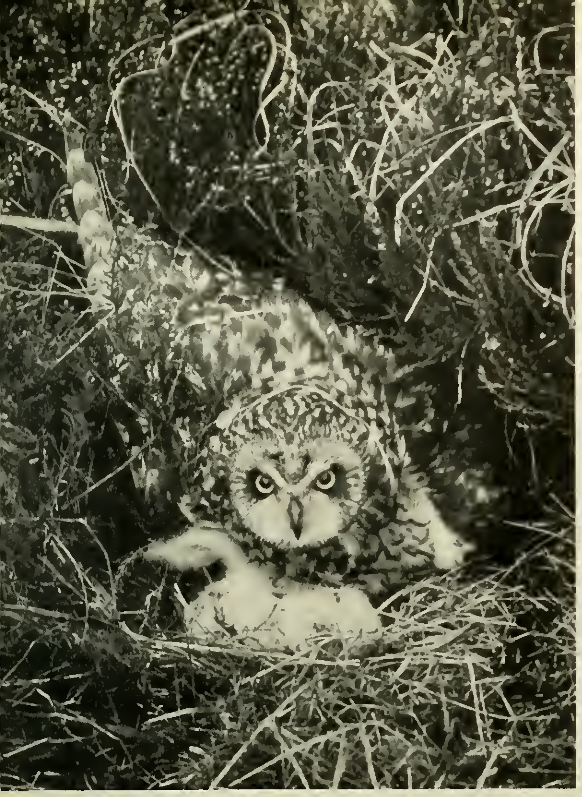
tle forbidding. In the transformation which April's sun has wrought, it is the short-eared owls which have played the most conspicuous part. Hillsides on which a mere 24 hours ago no birds had stirred have waked to life. The owls have risen from their beds in the grass and heather and all the daylight hours have been quartering the ground seeking their prey. These aerial masters have given of their best, and the superb ease of their silent flight has dominated the whole scene. The short-eared owl may not suggest in its flight the power which is implied in the soaring of buzzard or eagle; it may lack the feeling of headlong speed that is prompted by the peregrine's stoop; its performance may not even be as impressive as the practiced art of the kestrel's hover. Yet this owl flies with a grace and buoyancy unrivaled by any of its kind. Its long brown dappled wings carry it over the ground with an ease that makes the efforts of many of its bird neighbors on those moors look unpolished and amateur. The sideslips, the hesitant hover as it looks a second time at a grass clump beneath it, the quick plunge to earth that lands the bird all askew, its wings outstretched over the heather, are one and all the practiced skill of a peerless flier. Backwards and forwards over their beats they have been flying today, slipping and twisting, turning their heads now to one side, now to another, now looking back beneath them, taking their relentless toll of the mischievous rodents that would willingly eat like locusts the pasture of these sheep moors.

All this morning I was in the confines of my "hide," a mere eight feet off a short-ear's nest. We had found her ten days ago, with the unwitting help of her lord. For he it was we had been watching at his evening hunting. With eyes that grew weary through prolonged watching through the glasses, we had followed intently his progress over the moor. His spirals, his plunges, his momentary hovers, all had given us hope that he would soon kill food for his mate. That she was there, somewhere hidden away in the long moor grass on her white eggs, was no difficult deduction, for her lord had a territory well prescribed. Eastward an old fence turned him in his tracks; to the north his hunting followed the line of a newly cut drainage ditch. He rarely overshot the road that marked his southern boundary, while beyond a slight ridge on his other flank he swung about to resume his work. All this area now lay before our gaze. It seemed certain that in those many square yards of dried moorland grass his mate sat close upon her white eggs awaiting the meal which, now that it was evening, it was her lord's task to kill for her. And so we waited and watched, watched till our eyes were nigh on bursting with the strain. How often too he cheated us into false hopes! Time and again he wheeled on his course, to plunge back into the grass. Yet time and again he rose without that little brown lump in his talons which we eagerly looked to see—the vole that would send him speeding to his lady. Once he rose and in bee-line flight sped over the moor to his boundary. Had he food? Would he plunge in and give away his secret? It was yet another false alarm. A neighbor had violated his terri-

(Below) Back to her family on wings so silent that not the slightest rustle can be heard eight feet away

(Right) The piercing glare of a mother on guard. Six eggs changed into downy chicks during the observations





tory, and without ceremony was driven off. And so back to his wavy hunting, that patient and remorseless quartering of the ground by which he polices those vole-ridden moors.

Quite suddenly he killed. A quick plunge, a quick grab, and the deed was done. For a moment he looked around him, wings outstretched over the grass. Never once did he glance beneath him. Doubtless his talons told him their tale of success. When he rose, how different was his flight! Gone was that slow quartering; gone too the sideslips and the twists and turns. Straight as a die he sped over the moor, to plunge in again on the slopes of the slight ridge which was his eastern boundary. To our joy another owl rose beside him, a mere five yards away, and there we found a nest of six eggs.

And thus it was that I have spent the still loveliness of this April day a mere eight feet from the brooding owl. For a week now I have daily sat with her and watched her white eggs change into downy chicks. For three days we accustomed her to the hide, an easy task, for she had but little fear of man and refused to jump until the hand was about to touch her. Thus our comings and goings disturbed her little, and she grew used to the canvass tent that rose slowly from the grass beside her.

All this time her eggs have been hatching, not all within a short space of one another like most birds, but haphazardly as is the way with owls. On April 17th she had two chicks, and when she rose from the nest she tossed them high into the air like two pieces of fluff. Two days later three downy balls were scattered to the wind as she flew off. On the 20th yet another had emerged; on the next day one more, but the sixth came to life on the 25th—a full eight days after its eldest brother and with a correspondingly poor chance of survival, I imagine.

Development indeed has been remarkably slow. True, the two helpless tiny chicks which the old bird tossed to the four winds when we first found her have grown markedly in size. They swell almost visibly overnight. Their white down has become a dirty gray. But there has been no apparent simultaneous increase in strength. Until yesterday, exactly a week after hatching, they were still blind. They show no signs of real life, seeming satisfied to lie half dead in the nest, inanimate balls of fluff.

Nor has the female owl encouraged them. The kindliest of mothers, she has on returning to her duty been content to brood them, and activity of any sort has been conspicuous for its absence. Her arrival, indeed, has been the high spot of each of my periods of observation. It is an uncannily silent performance. One moment the nest is untenanted; at the next the hen bird is standing by its side, staring straight at the hide with those beautiful pale yellow eyes. There is no warning. Those long wings beat so silently that not the slightest rustle penetrates to the ear a mere eight feet away. Only the talons, as they grip the grass, give any clue of her coming. Then with a slow crouching walk she shuffles onto the chicks, and broods. Thereafter she sleeps in the sun or crouches out of the wind, a charming study in dappled browns.

As the spirit moves her, she rearranges the young beneath her, pulling her head back and squinting awkwardly down her breast. Occasionally she preens herself, and strange are some of her positions. Her head seems detached from her body and capable of turning round in a full circle. Yet she has done little else. Only once have I seen her feed them. This morning on my arrival there was a vole in the nest. As usual she returned within a few minutes, but the dead vole was ignored, until an hour or so later two chicks appeared under her wings and pushed their heads into the light. She now seized the prey and tearing it into tiny pieces fed the chicks in turn. The young satisfied, she opened her wide mouth and in a trice the remainder of the vole vanished within, and without so much as a visible gulp she settled down to sleep again.

In the quiet peace of this evening the cock has been busy at his display. All day long he has scoured the hillside for voles. Now with appetite sated he rises high in the sky and with steadily beating wings holds the same position in the upper air. A low, far-carrying *boo-boo-boo* note resounds at frequent intervals. Unexpected dives break the monotony of this performance. On a sudden the wings are clapped together beneath the body and the bird takes 200 feet of twilight in the twinkling of an eye. From this plunge he sweeps back into his original position and once more marks time, until once again the spirit moves him to plunge earthwards in that ecstatic dive. When I left him the light was fading and only his incessant note told me that this bird of both day and night was still at his duty post.

Natural History

ILLUSTRATIONS

are printed from photo-engraved plates made by STERLING ENGRAVING COMPANY, 304 E. 45th Street, New York, N. Y.

COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

Filter For Your Color Shots

By CHARLES H. COLES

Chief Photographer, American Museum of Natural History

COLOR films may play tricks upon us in a most disconcerting way. You may photograph a white dogwood blossom and have it turn out blue. A green leaf sometimes comes out brown, and a yellow oriole a vivid green. These eccentric results are the color film's response not only to the color of the subject but also to the conditions under which the picture was made.

Color film can't think, so you'll have to do that job for it. The use of corrective filters is the key to a high batting average in getting good Kodachromes. It will surprise many camera fans that there are more than a dozen corrective filters available to adjust the color response of Kodachrome and Kodacolor.

The changeover filters

By means of these filters, an emulsion that is color balanced expressly for daylight may be used for filming indoors under artificial illumination. Photoflood light is very deficient in blue compared to daylight, so the changeover filter emphasizes what little blue there is. This filter is blue in color, therefore. It is #80 in the Wratten Filter series. It will convert all Kodachrome Regular and Kodacolor film for use under Photoflood illumination — but here's a warning. The speed of the film is reduced to one-third its normal value. So, be sure you have plenty of light.

The second changeover filter, as you may have guessed, changes the response of Type A Kodachrome so that it may be used in daylight instead of the artificial light for which it is designed. This indoor film has an exaggerated sensitivity to blue light so as to record properly the small amount of this color given off by artificial illumination. To reduce this excessive blue sensitivity when the film is used outdoors, a salmon-colored filter, a Wratten #85, is slipped over the lens.

The fact that this #85 filter converts Type A Kodachrome to daylight use with no loss in speed as compared to the Regular Kodachrome, makes it very popular with the amateur. He keeps his camera loaded with Type A film and is ready to shoot outdoors or in by merely slipping on or off the filter. The disadvantage of this arrangement, to my mind, is that all the outdoor shots have to be made through a filter,—and no filter, no matter how good, improves the definition of a picture.

The ultra-violet filters

Although color film does a pretty good job of reproducing things that you can see, you may be surprised to find that it also reproduces things that you can't see. Invisible ultra-violet light, that sun-burning element in sunshine, will record on Kodachrome as a blue haze. This becomes especially serious where ultra-violet is abundant, as in high altitudes. To reduce this excessive blueness, filters that absorb ultra-violet have been manufactured.

The so-called Haze Filter, or Wratten #1, is designed to absorb strongly the ultra-violet without affecting the visible light. Placed over the lens of a color camera, it will reduce slightly the bluishness of distant scenes. On the whole, its effect is very slight. No change in the lens aperture is therefore required.

A filter with a stronger ultra-violet absorption is the 2A filter. This is a faint yellow filter and has a much more positive effect upon Kodachrome than might be expected from its delicate color. It is definitely useful to improve the warmth of scenes taken where no sunshine falls. Pictures made in the shade and on cloudy days will benefit from its use. No increase of exposure is required.

The color correction filters

These are faintly tinted filters used to correct slight deficiencies in the color of the light so that the tones will appear true in the final picture.

As an example, suppose a Kodachrome is to be made of a habitat group in a museum. These groups are illuminated usually by ordinary incandescent lamps which operate at a color temperature of about 2800°K. At this temperature light possesses a strong yellow color with very little blue. Kodachrome A, the indoor color film for miniature cameras, is corrected to the color temperature of the photoflood lamp, but this operates at 3450°K. and gives a much bluer light. To accentuate the small amount of blue in the habitat group and prevent the picture from turning out too yellow, a bluish filter—CC 6—is used over the lens, which raises the apparent color temperature of the lights to that to which the film is balanced. The color of the final picture thus appears to be in correct balance when we look at it.

The bluish color correction filters, the CC 3, 4, 5, and 6, raise the apparent color temperature of the lights by which the picture is taken. If by any chance the lights happen to be too blue, the yellowish color correction filters, the CC-13, 14, 15, are pressed into service. These filters are useful to overcome the bluish color of photoflash lamps and make colors taken by this light record truer on the film. Each higher number in the color correction series represents a deeper color in the filter.

Deficiencies in certain colors call for the use of the complementary color correction filters. CC 23, 24, and 25 are lemon yellow in color to emphasize that color in the final picture. Magenta colored filters, CC 33, 34, 35, will make the camera view life through rose-colored glasses. CC 43, 44, and 45 are green filters to strengthen the film's response to green.

Thus it is evident that, although Kodachrome and Kodacolor have no brains with which to decide what color is wanted in the final picture, the photographer has ample opportunity to use his in the selection of one or more of the various filters, so that the completed picture will show the colors as he saw them, not as the film would have reacted to them.

Agfa Ansco
PLENACHROME FILM
MADE IN U.S.A.

The right camera angle is part of the secret of every good picture. Notice how rider and lariat are sharp against the sky. But it's even more important to use the right film—Agfa Ansco Film. It is guaranteed: *"Pictures that satisfy or a new roll free!"* For sparkling outdoor pictures, insist on Agfa Ansco Plenachrome. Its extra margin of quality minimizes many exposure errors! ***Agfa Ansco, Binghamton, N. Y. 100 Years of Service to American Photography.***

YOUR NEW BOOKS

THE SILVERSMITH IN MEXICO ● CANADA'S DOMINION IN THE NORTH
AMERICAN FRESH-WATER FISHES ● DIAMONDS ● EDENS

CANADA MOVES NORTH

- - - - - - - by Richard Finnie

Macmillan, $3.50

ONTARIO'S *Public School Geography* has been informing school children that, "In the extreme north the great ice-cap surrounding the Pole prohibits all plant life. This area is . . . called the *ice-desert*." Meanwhile, wheat is ripening at Good Hope just south of the Arctic Circle, and the Northwest Territories west of Hudson Bay continue to support 750 species of flowering plants and ferns. Canadians who have ventured to see for themselves are building a thriving dominion in the North, not on an imaginary ice-cap but in a land where all snow quite prosaically melts at 32 degrees F. and summer temperatures rise to 70, 80, and 90 degrees.

If you flew from San Diego to Oslo by the shortest route, you would want to stop halfway at Baffin Island. From New York to Manila your most direct course would carry you across the Arctic Coast of Canada. Thus the section of the Western Hemisphere farthest from the beaten track, breaks through a veil of ignorance and confusion as the future aerial crossroads of the world.

The man who knows Canada's Northland is Richard Finnie. The book that gives the best account of its human and economic meaning to the world is *Canada Moves North*. Finnie was born in Dawson City and since 1924 has traveled far and wide in Arctic Canada. He is a scrupulously accurate observer and in his story uses no miracles to lift Cinderella from obscurity. If the land has not yet reached its proper destiny, he offers proof that man's own ignorance and mismanagement are to blame. His discussion of the problems faced by the Indians and Eskimos is a valuable contribution, full of good judgment.

This book of lasting value will appeal to everyone interested in human geography. No home library with aspirations should be without it.

EDWARD WEYER.

PLANT FAMILIES— HOW TO KNOW THEM

- - - - - - - - - - by H. E. Jaques

Pictured-Key Nature Books, Mt. Pleasant, Iowa, $2.50 (Spiral binding, $1.50)

FOR a serious beginner in the study of botany this is a very helpful manual since it contains illustrated keys for determining the families of nearly all of the members of the entire plant kingdom. It thus avoids the usual objection to popular works on mushrooms, or flowers, or trees, or any other group of plants—that they contain such a small proportion of the entire group. This little book has the completeness of an unabridged dictionary as compared with a small desk dictionary.

Every step in the keys is illustrated by good clear line-drawings, and this has made it possible to reduce the text to the minimum. At the close of the book is a phylogenetic list of the families of plants, and an index and pictured glossary.

The author is Professor of Biology in Iowa Wesleyan College, and the book has evidently come out of his actual teaching experience.

CLYDE FISHER.

REPRESENTATIVE NORTH AMERICAN FRESH-WATER FISHES

- - - - - - by John T. Nichols

Illustrated by Andrew Janson
Macmillan, $1.25

THE publishers of this volume indicate that it is intended for anglers "or anyone else interested" and then go on to say: "We have asked John T. Nichols, Curator of Recent Fishes, American Museum of Natural History, to prepare the text for this brief introduction to the Science of Fishes (Ichthyology)." Following this expression of intent we find that there are 60 plates, one species to a page, each faced by a page of text. Of these illustrations, some of which are very good and all satisfactory, 29 are in color.

The author's approach to the subject is perhaps best described in the publisher's own words, as follows: "Mr. Nichols has packed a great variety of data about fishes into a limited space. We hope that this glimpse into this fascinating science of fishes will lead you to wider investigations and open up a new field of interest." With this latitude Mr. Nichols has set forth, in one-page briefs, data on each of the 60 species. Through these he has contrived to weave, in true Nicholesque fashion, remarks on phylogeny, life history, and habits, often also indicating what is unknown.

It occurs to the reviewer that this is just the kind of a book that should fall into the hands of a boy in his teens. The meditations of such a natuaralist as Nichols are necessarily stimulating, especially to one in formative years.

To attempt to criticize small details would be carping indeed on such a disarmingly composed book. The fact that the fishes are not arranged in any conventional order is presumably a concession to the maintenance of the conversational nature of the sketches. The Index is excellent.

Nichols' comments on 60 species of fishes, with good pictures of as many, for a dollar and a quarter, is a buy at any time.

C. M. BREDER, JR.

THE ART OF THE SILVERSMITH IN MEXICO, 1519-1936 —(2 vols.)

- - - - - - by Lawrence Anderson

Oxford University Press,
Limited Edition, $30.00

THE Art of the Silversmith in Mexico is a work of profound scholarship. It is perhaps the first basic work of true scholarship on one of the important arts of Mexico. Perhaps only the great work of Baxter approaches the exhaustive quality of Major Anderson's study.

The fascinating thing about this work is how the native population of Mexico took over many of the Spanish arts and skills and from them created their own. The silversmith's art was notable, and one of the glories of colonial Mexico was the beautiful artistry of this craft which became more than a craft, in fact a true art. The Spaniards knew keenly all the values of high craftsmanship, and one of the most interesting features of Major Anderson's study is how their skillful legislation and control allowed them to maintain a high, noble standard of work. The carefully documented text and the superb illustrations bring out these features in a striking and imposing way.

The greatest possible credit is due Major Anderson, for despite his arduous and exacting duties as the executive of a large American business he found time not only to collect specimens, but also to pursue a tortuous trail through early Spanish documentation. There was no one before him to blaze the way. He and his assistants had to start from the beginning and assimilate the material out of which this imposing work is the result. This book was expensive to produce and it is not within the reach of everyone; however, the student and the artist by going to a library can take this superb work and consult its manifold examples and documents. In these days of growing interest in Latin

America it is refreshing to find a path so well defined on which to build a lasting structure of knowledge on which true understanding depends. In *The Art of the Silversmith in Mexico* Major Anderson deals not only with the field of art but also with the fields of law and history and affords as well important data for anthropological and sociological study.

GEORGE C. VAILLANT.

VANISHING EDEN

- - - - - - - by Martin Birnbaum

Rudge, $5.00

MARTIN BIRNBAUM should be a familiar name to the readers of NATURAL HISTORY Magazine since his brief, illuminating travel narratives have appeared in its pages at frequent intervals. He is a world-wide traveler who seeks out the unspoiled havens where aboriginal life survives—"Edens" he calls them, because they are free from the shallow commercialism tourists leave in their wake.

The eleven chapters of the book range through Central America, Asia, Polynesia, and Africa. There is a vivid word picture of the Sahara Desert—the best we have ever read, a touching account of life in Bali, an intimate view of Yünnanfu and the Burma Road, and informing notes on Maya-land in Guatemala and Yucatan. NATURAL HISTORY readers and visitors to the Akeley African Hall will read with interest the descriptions of the Mount Mikeno country, Africa, where the body of Akeley lies in its lonely grave. Again they will enjoy the sketch of Patrick Lowell Putnam and his jungle home in the Ituri country of the upper Congo area. The names of many other familiar explorers and writers met by the way will thrill the reader as the author meets them in out-of-the-way places. The numerous photographs are of unusual excellence.

CLARK WISSLER.

NEEDLE TO THE NORTH

- - - - - - by Arthur C. Twomey
(with Nigel Herrick)

Houghton Mifflin, $3.50

THE east side of Hudson Bay is singularly bleak and wind-swept, cold in winter, inhospitable to man even for northern Canada. Sixty miles or so off its coast lie the Belcher Islands, a series of more-or-less parallel, barren, rocky ridges, trending east of north. About an equal distance from the shore into the interior of Ungava is a fresh-water lake known to be inhabited by seals that had never been collected and described prior to the Carnegie Museum of Pittsburgh expedition in 1938, of which this is the narrative.

In the late winter of 1937-38, A. C. Twomey and J. K. Doutt of the Pittsburgh Museum went north, reached the lake from the coast by dog team and collected specimens of the seal, crossed to the Belcher Islands by the same means just before the ice jam between islands and mainland broke, and remained there until August, observing the return and nesting of the few land birds and many seafowl of which these islands are the summer home.

The book tells of the wild northern terrain crossed, of constant struggle against the inclement climate for which it is noted. In much detail it goes into the personalities of the few white men, the Ungava Indians, and the Eskimos of coast and islands on whose co-operation the expedition depended. Aside from being an interesting story of adventure, it is a record of value from several aspects. Always in the background there is the tragic picture of how inevitably the white man's blessings have upset the delicate adjustment between these northern people and their hard environment, and are proving false blessings for them in the long run.

The scientific records of northern beasts and birds—objective of the expedition—will be found published elsewhere. But scattered through this narrative are many references of interest to the naturalist. Such are the accounts of an old bull walrus bellowing the alarm from a rocky islet where his unsuspecting herd had been sunning and sleeping, until the last one had escaped into the water, and of the mating dance of the purple sandpiper.

J. T. N.

FIRE IN THE EARTH

- by James Remington McCarthy

Harper, $2.50

AN interestingly-written, popular account of diamonds, *Fire in the Earth* tries to tell everything of general interest about this unique mineral. The author has consulted many works and gives a fine bibliography. In addition, it is clear that he has taken advantage of the opportunity to talk to people in the trade and has thus attained a very practical approach to such things as color, cutting, and flaws.

We read in succession about the origin of the diamond, localities for diamonds, mining methods, the history of the De Beers interests, the arbitrary trading methods of that company, the cutting of diamonds, and the changes in the centers brought about by the war. There are chapters on the changing modes in diamond jewelry and cutting, famous pieces, and legends and superstitions associated with diamonds. A concluding chapter speaks of the industrial uses of diamonds—a recent discovery of the popular writers, though in some senses, actually as old as diamond cutting itself.

Interspersed between the practical chapters of instruction are short, italicized sections upon famous stones, like the filling in a layer cake. In them we re-read the familiar legends of some of the larger and better-known stones.

Fire in the Earth is a practical book with a practical approach and should be of great assistance to the potential purchaser of a diamond in that it shows

Continued on page 54

VANISHING EDEN — Know and understand the countries in today's headlines. A richly illustrated travel book including uncut versions of essays appearing in "Natural History Magazine"

By
MARTIN BIRNBAUM

280 Pages . . . $5.00

WILLIAM E. RUDGE'S SONS
INCORPORATED
225 Varick Street
New York

REPRESENTATIVE NORTH AMERICAN FRESH-WATER FISHES

By JOHN T. NICHOLS
Curator of Recent Fishes
American Museum of Natural History

EVERYONE interested in fishes will want this authoritative, pocket-sized guide with colored and black and white pictures, and descriptions of sixty common fresh-water fish. It tells their size, habitat, gives special characteristics and unusual items about each fish, common and technical names. It is a brief introduction to Ichthyology. The book is enclosed in a handy slip case. $1.25

MACMILLAN
60 FIFTH AVE., NEW YORK, N. Y.

Continued from page 53

the fallacy of investment buying and the security of trading with a reliable dealer rather than purchasing by price. Some sections become rather tiresome—one suspects that 250 pages are too many for a popular account of diamonds. Like many popular writers, Mr. McCarthy treats the experts cavalierly, accepting their conclusions about the antecedent of the Hope Diamond but denying their equally well-grounded decision about the non-existence of a Great Mogul. But there will be few complaints from the jewelers about this book, except from those not mentioned by name in the section on the purchasing of a fine stone.

F. H. POUGH.

ENJOYMENT OF SCIENCE

- - by Jonathan Norton Leonard

Doubleday, Doran, $2.50

"SCIENCE understood is usually interesting. Science not understood is almost always dull." With this consideration, the author has attempted, in this one volume to furnish an introduction to all of the principal sciences. They are grouped under three general classifications: the "life sciences" including biology, with all of its branches, anthropology, entomology, microbiology, and ecology; the "thing sciences" including geology, oceanography, meteorology, and astronomy; the "laws of the universe" including chemistry, physics, mathematics, and logic. In most cases there is a short description of the field covered by the science, and for each there is an annotated bibliography of the better works available to the average reader. In general these are the best parts of the book and should be most valuable to those who desire to browse intelligently through the sciences.

These discussions, interspersed with "digressions," as they are called, on such subjects as bibliographies, reader morale, books and libraries, make up the book. While certainly not of any great significance, it is one which I, personally, enjoyed reading.

H. E. VOKES.

STRANGE NEW WORLD

- - - - - - - by Alec Chisholm

Angus & Robertson, 89 Castlereagh St.,
Sydney, Australia

STRANGE NEW WORLD tells of exploration in Australia between 1839 and 1844.

Alec Chisholm's keen interest in the work of John Gould led him to England during 1938 in search of new material relating to Gould's life and work. He was unsuccessful in his quest but Gould's two great-grandsons had the diary and field notebook of John Gilbert, ornithologist and explorer, associate of Gould in Australia and later of the German explorer, Ludwig Leichardt. These papers were sent to England by Leichardt after Gilbert's death. No mention had ever been made publicly of Gilbert's notes during the 90-odd years which elapsed since Gilbert's death until they fell into Mr. Chisholm's hands.

The information given in the diary is the foundation for *Strange New World;* and since Gilbert's entries were made with great regularity and considerable detail, a clear and vivid picture of the expeditions and the personalities of the various members of the parties is presented to the reader.

The first part of the book is devoted to Gilbert's early work of exploring and collecting birds in Tasmania and Western Australia, while the second part describes Leichardt's expedition from Brisbane to Port Essington near Darwin, during which Gilbert so tragically lost his life at the hands of Australian blackfellows.

Mr. Chisholm admires Gilbert greatly, and is strongly prejudiced against Leichardt, whom he considers incompetent as a bushman and totally lacking in the qualities of leadership. Nevertheless, though the trip from Brisbane to Port Essington took many months longer than had been calculated and entailed much suffering and hardship for the entire party, it brought lasting honor to Ludwig Leichardt.

YVONNE A. RAVEN.

A REPORT ON EXPERIMENTS WITH COLCHICINE

BY LAYMEN SCIENTISTS DURING 1942

- - - - - by O. J. Eigsti and Barbara Tenney

University of Oklahoma Press, 35¢

COLCHICINE is a chemical which causes hereditary changes in plants. If applied to the growing portion of a plant it has a power to produce variations which are transmitted to following generations. Thus it promises to be a useful tool in the development of better types of plants. This 32-page booklet summarizes experimentation with this chemical during the past two years and explains to interested laymen the manner in which it is possible to participate in the Co-operative Research Project under the guidance of the University of Oklahoma.

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NAME THAT ANIMAL

- - - - - - by Ernest C. Driver

119 Prospect Street, Northampton,
Mass., $5.00

THE author, who is Associate Professor of Zoology at Smith College, sets forth in the Preface that the purpose of this book is to provide the reader with a practical key to the identification of land and fresh-water animals. It covers more ground than any single volume of the kind known to this reviewer—every group from the one-celled animals (Protozoa) to the mammals being treated. Along with the Protozoa, a small section is devoted to diatoms, desmids, and other small algae—plants that are found associated with microscopic animals.

We are reminded that the land and fresh-water animals include members of all the major groups or phyla of animals except the brachiopods, ctenophores, and echinoderms, which live exclusively in salt water. Abundant line-drawings facilitate the use of the keys. These constitute a simple and clear method of defining terms and characters used in the keys, and make it possible to keep the text brief. Following the key to each group is an excellent list of up-to-date, more complete, systematic works for those who wish to go further.

The type of key used, Doctor Driver says, is one that he has found "after much experimentation with students and long-suffering friends, to be easiest to operate." The book is a field manual for all except very small forms, and the keys are not based upon characters revealed only by dissection.

Beginners and nonprofessional zoologists, we believe, will welcome so inclusive a field book as this in one volume of just a little more than 500 pages —a veritable *multum in parvo.*

CLYDE FISHER.

CONE-BEARING TREES OF THE PACIFIC COAST

- - - - - - by Nathan A. Bowers

Whittlesey House, $2.50

EVERY Easterner who visits the western states must be impressed with the conifers or cone-bearing trees of the region, and many are interested to know their names. Here we have the largest tree in the world, the tallest tree in America, and one or two of the rarest ones of our country. And what a variety of conifers there are in the west! Seventeen kinds of pines, seven firs, five spruces, two hemlocks, three larches, seven cypresses, five junipers, two sequoias, and several others. And here is a complete popular manual for one's side coat-pocket that makes their identification easy. It contains an abundance of fine photographic illustrations, excellent drawings of needles and cones, and three kinds of keys, namely, the Needle Key, the Elevation Key, and the Geographical Key.

CLYDE FISHER.

ANTIMONY *Continued from page 33*

three forms, the melted sulphide, often known as crude antimony, the concentrated ore, and refined antimony. Regulus, an old word still in use for antimony metal, comes from an ancient reference to its affinity for gold in the smelting of a mixed ore. "Star antimony" is a variety whose spangled surface is thought to indicate especial purity, though it actually is caused by the manner of crystallization under a cap of still molten slag. The refining of antimony is not difficult. Regular blast furnace treatment reduces the oxides, and the sulphides are purified by heating the ore with iron which makes antimony metal and an iron sulphide. The compounds of antimony are very volatile, however, and to avoid undue loss in the treatment, precautions must be taken to catch the escaping gaseous portions.

Antimony has more direct military applications than any other of the strategic metals, and a higher proportion of the annual consumption goes into military uses. They are very important uses too, and the most important is allied to the principal civilian use. That is in the hardening of lead. From a military standpoint it is used to harden the cores of bullets and shrapnel balls, and G. A. Roush, in his *Strategic Mineral Supplies,* also says that the sulphide is used in the bursting charges of shrapnel to form a dense white smoke making easy observation of the place of burst. Some sulphide is used in the percussion caps of rifle and artillery cartridges, and it has been said that the natural mineral is better than an artificial sulphide for this purpose.

The principal uses of antimony in the hardening of lead are the same in peace as in war. Battery plates probably account for the greatest consumption. Type metal is another great consumer. Castings of pure antimony are sometimes made, and antimonial lead castings were used in some auto trims. Not only is antimony valuable in rendering the lead harder, but it is also useful in preventing the shrinkage which lead undergoes in cooling, a factor of some importance in the rapid casting of type. The content of antimony varies according to the use. Linotype letters once used and then remelted contain less antimony than loose type which is set and reset for many printings. Antimony is used in bearings, and is often a substitute for tin.

All of these metallurgical uses—battery plates, cable coverings, and type metals—destroy very little of the metal, so that a large amount of the annual antimony supply is in the form of reclaimed metal. Some uses, however, remove it permanently from the market. The commonest example of this sort and one that affects everyone, is in the heads and on the striking surface of safety matches. An antimony sulphide is used here. White enamels and white paint pigments use some of the oxides. An early method of vulcanizing rubber used a complex sulphide which broke down to a simpler red sulphide and free sulphur, which did the vulcanizing. This practice has almost disappeared, but the red coloration of rubber that it started is still with us.

Britannia metal, pewter, Babbitt's metal and other white metal alloys also use some antimony. We shall probably notice a reduction in their use. Pewter will no longer be a popular item in the department stores, but we shall certainly not be as embarrassed by this wartime problem as we should have been a few years ago. In 1931 a smelter for Mexican ores was opened in Texas, and today the Mexican and Bolivian production fill most of our needs. Some American production is also to be noted, and a guarantee of prices higher than ten or twelve cents a pound (now it is fifteen cents) for a period of two years or so, would undoubtedly bring about more domestic mining. No one wants to gamble on a plant which may take a year to build, with no assurance that at the end of that time he will have a market that will repay the cost of development and exploitation.

You may not be able to get a new battery when you need one, you may not be able to get a new pewter bowl, and your candlesticks and coffin plates may be of some other substance, because of the extra need for good hard shrapnel and easily visible anti-aircraft bursts, but thanks to recent developments we needn't worry too much about our antimony supplies. The Texas smelter commenced operation in 1931, so we cannot attribute our present status entirely to recent war developments, but rather to part of long range planning to exploit nearer sources of supply. However, at the same time, we can hold out no hope for an Axis shortage of antimony, though the transportation problem should give them a headache.

INFORMATION TEST

A few informational high spots that may be gleaned from this month's Natural History

Correct Answers on page 56

1. Fifty-five species of wild orchids grow in
(a) Hawaii
(b) Bermuda
(c) Vermont

2. What strategic metal is vital in the lead plates of your storage battery and in the type from which this page was printed?

3. The most beautiful Navaho blankets were woven before the white man came to America.
True......... False...... ..

4. The plant which gives Arizona its state flower attains a height of 40 feet and is threatened with extermination. What is it?

5. Rabbits never swim.
True......... False.........

Do you remember the answers to these questions from last month's Natural History?

6. What country in the Western Hemisphere produces the most diamonds?

7. How do some modern laundries mark their customers' clothes without using any visible writing?

8. An anachronism is something out of place with regard to time. What is an anachorism?

9. What is an elver?

10. What mother in the animal kingdom suckles a baby fifty feet long?

OUTFITS FOR EXPEDITIONS

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Owing to War Time Restrictions
NEW HAMPSHIRE NATURE CAMP WILL NOT HOLD ITS SESSIONS THIS SUMMER

WYOMING

The Patons welcome a limited number of guests at their ranch home in the Big Horn Country. There are excellent opportunities for color photography, daily horseback rides, fishing, good ranch food and comfortable quarters. Ideal for a family vacation. Restricted. Write—

PATON RANCH. Shell, Wyo.

Answers to Questions on page 55

1. Vermont has 55 species of native orchids, whereas Hawaii has only three and Bermuda none. See page 34.
2. Antimony. See page 32.
3. False. When first discovered, the Navahos did not raise sheep. See page 31.
4. The giant cactus, or saguaro. See page 22.
5. False. The marsh rabbit, found in some of our southern states, enjoys swimming. See page 27.
6. Brazil produces the most diamonds in the Western Hemisphere. See May issue, page 268.
7. By using inks that are invisible until they are flooded with ultraviolet light in a darkened room. See May issue, page 290.
8. An anachorism is something geographically out of place. See May issue, page 250.
9. An elver is a young eel. See May issue, page 257.
10. The blue whale, or sulphur bottom. See May issue, page 285.

NATURAL HISTORY MAGAZINE
NATURAL HISTORY MAGAZINE

★

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NATURAL HISTORY Magazine

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WILD ORCHID SANCTUARY

Continued from page 39

heritage. They have persisted through the vicissitudes of time, from possibly 60 million years before the coming of man.

With the vanishing of wild orchids from the American countryside we have seen also the disappearance of many of our rarer birds. One must live in the country to realize how the woodcock, veery, and warbler have dwindled from year to year in their swampy environments. It should be a criminal offense to offer any American lady's-slipper for sale. The commercial traffic in these rarities should be stopped at once. The few haunts in which they survive should be located at the earliest possible date so that the survivors can persist in Federal and State sanctuaries. Otherwise nature lovers of the coming generation will miss the fascination and joy that is associated with the living reality.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Summer, 1942.

SUNDAYS over the Mutual Broadcasting System (WOR) from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

•

WEDNESDAYS, June 3, and June 17, over WNYC from 3:30 to 3:45 P. M.

Know Your Museum.

•

FRIDAYS over the Columbia Broadcasting System from 4:15 to 4:30 P. M.

Exploring Space. A new dramatic series about astronomy and its practical applications.

URGENT

The Museum Library is in need of back issues of NATURAL HISTORY, particularly the first four issues for 1942. Copies sent to the Librarian, The American Museum of Natural History, New York, will be greatly appreciated.

September

NATURAL HISTORY

1942

Nickel • Talking Drums of Africa • Quinine and the War

Raymond B. Fosdick: A Malarial Invasion • Migration

VOLUME L. No. 2

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Descriptions and illustrations (many in color) of sixty representative North American fresh water fishes. An invaluable aid in identifying most of the species which the angler may encounter; pocket size. By the Curator of Recent Fishes, American Museum of Natural History.

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LETTERS

SIRS:

. . . Your Magazine, NATURAL HISTORY, gives me far more pleasure than any other magazine I have ever received.

Allentown, Pa. CONRAD W. BAKER.

* * *

SIRS:

I expect to be drafted into the United States Army in the near future. However, I would like my copies of NATURAL HISTORY sent to my present address until further notice. . . .

If I am not in a position to renew my membership next February, this will not signify lack of interest in the splendid work of our museum.

It seems to me that in these times, when civilian activities are limited in one way or another—and may be more greatly limited in the future—all those who do not take an active part in the war will have an excellent opportunity to broaden their interests. This is where your Magazine and Museum come in.

I trust no government will take action to limit the activities of such educational institutions as the American Museum. Someone, many persons rather, will have to keep the torch of truth aflame whilst other fires are burning in other lands. . . .

New York, N. Y. CHARLES PHILLIPS.

* * *

SIRS:

To a person whose duties keep him well tied down a long distance from New York, your excellent magazine is an important contact with the live program of the Museum. Your April number was terrific. Even an anthropologist, and particularly one who is interested in museum matters, can get tremendously excited over those photographs of animals, plus maps and just enough carefully worded text to make one wish he could hop on the next train and take a look at the groups themselves in the Museum.

Browning, Mont. JOHN C. EWERS.

* * *

SIRS:

. . . I have enjoyed every issue of this beautiful magazine during the past year—each number has seemed to excel the previous issue—truly a joy to lovers of the beautiful.

St. Louis, Mo. ANNA M. SINGER.

* * *

SIRS:

I have just received my first issue of your magazine and cannot refrain from expressing to you a deep feeling of remorse. This feeling stems from the pleasure I derived in reading the contents of NATURAL HISTORY and the realization of what I have missed these many years.

Here, I have been a neighbor of the magazine for some time, and yet I never knew it. I will admit that I had been under fire from some of my patients, but I resisted their influence up till now.

I want to tell you how glad I am to be a subscriber now, and that henceforth NATURAL HISTORY will occupy an important place in my waiting room.

GABRIEL R. VOGELSON, D.D.S.

New York City, N. Y.

* * *

SIRS:

I have always enjoyed being a member of the Museum. Somehow that makes me

NOTICE

Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

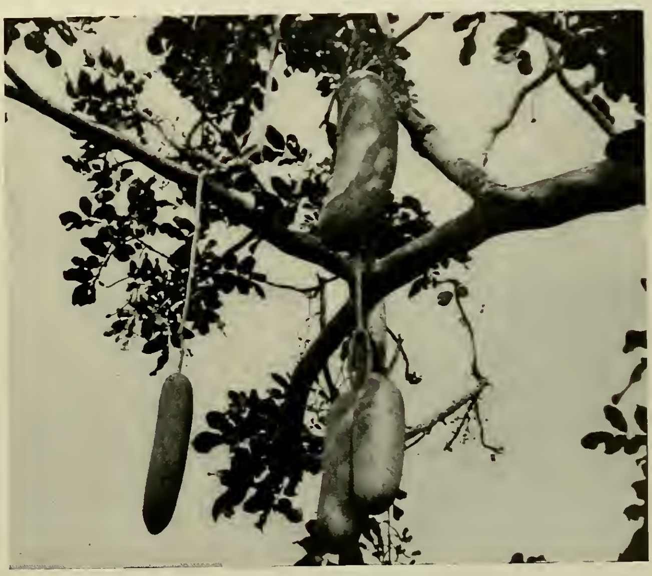
A TREE THAT SEEMS TO GROW SAUSAGES

By DAVID FRANKLIN MARTIN

The first time you look at it you would swear that it had produced a crop of sausages. But actually the strange shaped objects it bears are the natural fruit of the so-called Sausage Tree and are used in the making of medicine by the natives of the Mozambique section of Africa. The tree is held in high esteem by the natives, who consider it a sacred tree.

Few of these trees *(Kigelia pinnata)* are to be found outside the section of Africa where they grow naturally. Some have been transplanted, but for the most part they do not seem to do well and seldom increase with the same rapidity as some other foreign trees and plants.

The one shown in the accompanying illustration is to be found on a little island adjacent to the Venetian Causeway which connects Miami with Miami Beach in Florida, where it attracts much attention from visitors from other parts of the country.



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1. This contest is limited to NATURAL HISTORY Magazine subscribers in the United States. Employees of the American Museum of Natural History and their families, and professional magazine solicitors, are not eligible.

2. To qualify for the contest, you must send in at least three new subscriptions. Each contestant sending in five new subscriptions will receive a one-year renewal of NATURAL HISTORY free.

3. Payment of $4.00 must accompany each subscription.

4. Renewals will not be considered new subscriptions.

5. In case of ties, the tying contestants will be required to submit a letter of not more than 50 words setting forth the merits of NATURAL HISTORY Magazine, and the award will be made to the contestant submitting the best letter.

6. All subscriptions must be received on or before October 10, 1942, or bear the postmark of that date. Winners will be announced in the November issue of NATURAL HISTORY.

7. Envelopes containing subscription forms may be procured from the Membership Secretary.

Contest closes October 10th.

Address all communications to:

Membership Secretary, The American Museum of Natural History,
New York, N. Y.

feel that although I am busy teaching and do not have much time for research, I can do something to further my work. Besides, my students enjoy reading my copies of Natural History. Perhaps some day I can take a group of my pupils to the Museum for firsthand information.

Richmond, Va. Lyndele A. Pitt.

* * *

Sirs:

. . . May I take this opportunity to compliment you on the magazine of our organization. Aside from its interesting contents, it is a really beautiful example of printing art. . . .

. . . I find it a comfort in these days of strain to turn to interesting accounts of what happened to this old planet and its inhabitants during the millions of years of the past. . . .

Charles Larned Robinson.

New York, N. Y.

* * *

Sirs:

I want to tell you how much Mrs. Maris, our two boys, and I enjoyed our visit to the Museum yesterday, and I want especially to say that the interesting and kindly guidance of Miss Reddy added a great deal to our enjoyment.

I, myself, had never realized just what a remarkable institution the American Museum of Natural History is. I cannot express too highly my admiration for the quality of your work.

Philadelphia, Pa. Albert B. Maris.

* * *

Sirs:

Your letter containing a membership ticket for the American Museum of Natural History has just been received, and I am enclosing herewith my check for $10.00.

At this time, it gives me great pleasure to say to you that I regard this membership as one of the most desirable of the organizations to which I belong, and your Natural History Magazine is certainly an amazingly interesting and instructive publication. My children and grandchildren enjoy it greatly. It is, in itself, worth more than the cost of the membership.

Upper Montclair, N. J. Alan West.

* * *

Sirs:

I have spent many lonely hours in this U. S. O. club reading your magazine and received a great deal of pleasure in doing so.

Being in a "Task Force" it will be impossible for me to continue reading future publications, and therefore I would like to know whether you have any gift subscriptions for service men.

Thanking you for your kind consideration, I remain,

Cpl. James Lewis.

New York, N. Y.

Natural History does not have any gift subscriptions at its disposal but welcomes such for men in the

Continued on page 112

PURE RESEARCH IN A NATION AT WAR

Like all social institutions, museums must remain ever conscious of their responsibilities to the society which provides their means of existence. Conversely, society cannot afford to lose sight of the benefits, immediate or remote, derived from the institutions to which it gives sustenance.

In times of national emergency and under the stress of wartime psychology there may occur a foreshortening of perspective, a narrowing of focus in social consciousness. In combating a social order that has capitalized on the immediate destructive powers of certain phases of science, the democracies could easily lose sight of the far-reaching rewards of other types of scientific research which are lacking in immediate practical application. It is in just this sort of pure research that museums have traditionally specialized.

Realizing the imperative necessity for preserving the integrity of democracy's social institutions, the President of the United States has created a Committee on the Conservation of Cultural Resources. This Committee's report strongly recommends that "space in buildings, libraries, art galleries, museums and archival establishments be not used, even temporarily, for purposes outside of the natural sphere of these institutions, and that no other hindrances be placed in their way . . ."

A similar point of view is expressed in the introduction to the twenty-third annual report of the Commonwealth Fund, which so generously supports scientific research throughout the nation. "Not forever will force reign, not always will the organization of society—or its disorganization—preclude the benefits to mankind of scientific discovery, of knowledge, intelligence and understanding. Whatever philanthropic foundations can contribute to the forging of implements for a better day will not be lost."

Perhaps the most telling argument in favor of continued support of pure research during wartime is revealed in an editorial which appeared recently in an English scientific journal that carries reports of current experimental investigations. "At the beginning of the war it was decided to suspend publication of the *Bulletin of Animal Behaviour* after only two numbers had appeared. Contributions continued to come in, however, and the present issue represents a reversal of the original decision of the Council." The continued influx of scientific reports proves the survival of research in a country which has suffered some of the heaviest attacks of the war.

The determination of our government, our large philanthropic foundations, and our allies in war faithfully to preserve and foster pure research in the face of compelling emergencies is one of the most reassuring and faith-inspiring signs of the essential worth of our way of life. It actually demonstrates the refusal of democracies to sacrifice, even under terrific pressure, those tools which they have laboriously developed for the eventual betterment of human society.

Frank A Beach

Curator, Department of Animal Behavior,
The American Museum of Natural History

Clear the Lines for the War

Before you make a Long Distance telephone call today, ask yourself these questions:

1. Is it necessary?
2. Will it interfere with war calls?

The weight of war on the telephone lines is heavier every day. We can't build the new lines to carry it because sufficient materials aren't available. We've got to make the most of the service we now have.

Please give a clear track to the war effort by confining your Long Distance calls to those that are really necessary.

WAR CALLS

COME FIRST

BELL TELEPHONE SYSTEM

NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President
ALBERT E. PARR, Director

VOLUME L—No. 2
★ ★ ★ ★ ★ ★
SEPTEMBER, 1942

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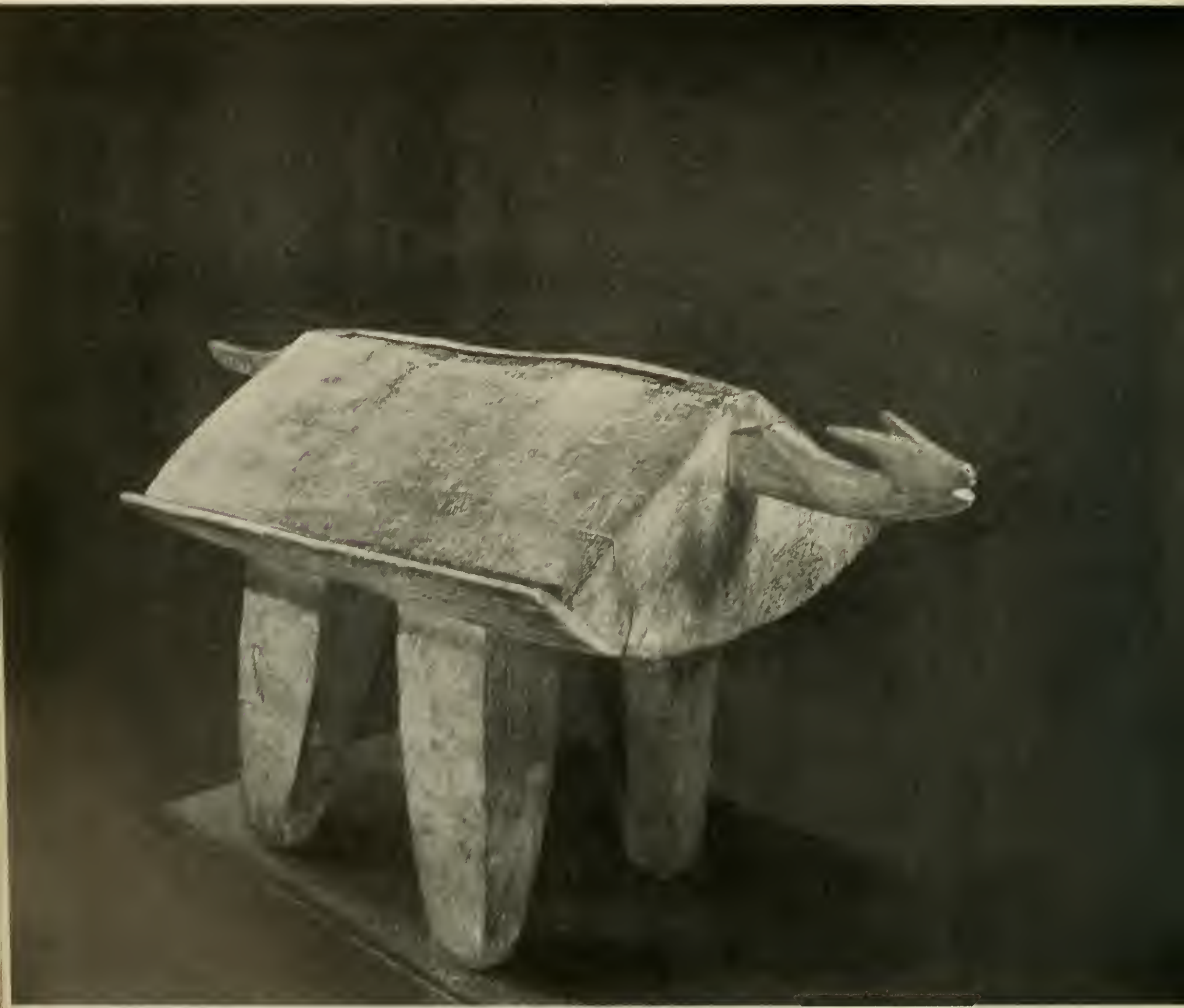
The travels of a TALKING

▼ Once used in cannibal country for sending messages from one village to another, this wooden drum is typical of the larger instruments that gave the native African a reputation for defying time and space in the transmission of news. Measuring 8½ feet long and 4 feet high, it projected over the sides of the largest dugout available for carrying it through the rapids of the Aruwimi



DRUM

By JAMES P. CHAPIN
Associate Curator of Birds
The American Museum of Natural History

Illustrated with photographs by HERBERT LANG

➤ CHIEF AHENGAMA of the Mabudu tribe, whose men made this drum. He was one of the most important chiefs near the post of Pawa in the northern Belgian Congo

Many adventures befell this signal drum and the explorer who procured it for the American Museum, before it could be placed on exhibit as a symbol of the primitive African's talent in the art of communication

IN A CORNER of the Hall of African Natives at the American Museum, for the past quarter-century, has stood a huge signal drum about four and a half feet high and five feet long, without counting its "head" and "tail" which protrude from the ends. Hewn from a single tree trunk, it has no skin drawn over it, for it is a "slot-drum" of the sort so widely used to serve as a "wireless telephone." Standing on four stout legs, with broad belly to give the utmost resonance, it was designed to suggest the form of a standing buffalo.

Many are the questions asked by visitors about this drum. Only the other day a teacher from Hampton Institute came to inquire with what tools it was made, how the wood was removed from the inside, and what kind of tree furnished the hard brown wood. Many a time have I gone to pound on its vibrant lips, evoking old memories of the country where it was made, the people who used it, the changes that have since come over their homeland, and above all, the man who enabled us to acquire it for the Museum.

Signal drums of this type are to be seen in many parts of the Belgian Congo, and in other countries of forested West Africa; but nowhere did they have a more interesting shape than in the country of the Mangbetu and allied tribes in the northeastern Belgian Congo. That region, often known as the Uele-Nepoko, after two of its rivers, has long been famous as a center of native art. Bountiful nature provided food without demanding too much effort, and leisure, under a warm, equable climate, was used intelligently in the development of social life and a surprising variety of handicrafts.

All was not peaceful, however, 75 years ago. The Mangbetu were then among the most celebrated of African cannibals, ruled over by kings like Munza, who tried to emulate Solomon in the size of their harems. Then some 50 years ago the Congo Free State extended its influence to Mangbetu Land; and the military activities of the Mangbetu and their rivals, the Azande, were frowned upon. Cannibalism was severely repressed, until it took refuge in the forests of the Nepoko area, finally disappearing as a normal practice only after the Congo became a colony of Belgium.

Under King Leopold's Congo Free State it was not easy to recruit in Europe the proper number of men with all the qualities needed for the wise administration of a distant, unhealthy wilderness in Central Africa. Among the Europeans attracted by the adventurous prospect of opening up the Congo to civilization there was bound to be a minority of reckless, irascible men; and though these were carefully weeded out as occasion arose, a few were apt to remain in the far corners of the country, even down to the days when the Congo came under the control of the Belgian Parliament and a wise Minister of Colonies. I can bear witness to the splendid achievements of the Belgians in Africa, and no other nation could have developed the Congo more fairly or efficiently than they.

As one who was in the Congo before the transformation was complete, before the introduction of money, I have always been deeply interested in the white men who brought the changes about, and even in those few who tended to retard them. Through later years I have kept in touch with as many "old Congolese" as possible, meeting them again from time to time, or hearing curious anecdotes about various well-known characters.

The echoes have been many, and with one of them I shall get back to the story of the drum. It was early in 1931, at Coquilhatville on the middle Congo River; and I was in a shop gathering up my change after making a purchase. Among the bills was one of rather large denomination bearing an engraved picture of a Mangbetu woman with her hair woven up into basket form. This bill was a new one to me, and I must have said so aloud, for a European standing close by put a question to me.

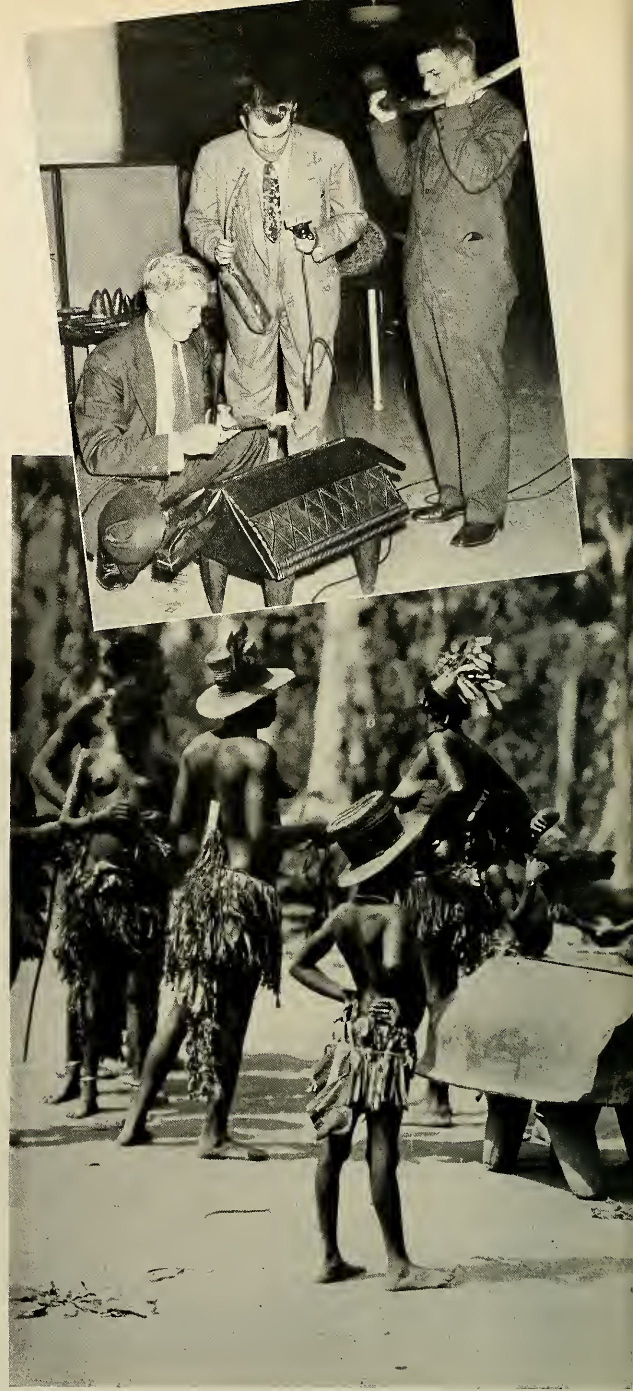
"What do you know about the Mangbetu?"

I had lived and worked among the Mangbetu in the northeast Congo some 20 years before, and I naturally asked what he knew. My new-found acquaintance introduced himself as Monsieur Boccaccini, owner of the little hotel of that name in Coquilhatville. He then informed me that he had been one of the white officers who took part in a military expedition against the Medje in 1903. In April of that year the Medje tribe, which may well be regarded as a southern branch of the Mangbetu, had killed and eaten an American named Thornton. But by the time Herbert Lang and I arrived in the district in 1910, the Medje were being governed peacefully from a well-built Belgian post on a hilltop in the Medje forests.

I don't recall that Boccaccini distinguished himself in the suppression of the Medje revolt—Major Engh and Carl Eriksson were better known for that—, but he knew something of Guyon. Chatting about these old times brought back a flood of reminiscences that extended all the way from this middle part of the Congo River to the little post of Pawa, near the borders of the Medje-Mangbetu district and back to the American Museum in New York.

Here in this town of Coquilhatville, sixteen years before, I last heard of Guyon, a compatriot of Boccaccini, and the man who helped us secure that exceptionally fine drum for the Museum. The drum had been made by Mabudu people, but Medje, Mabudu, and Mangbetu lived as close together as people might in three different counties of New York State. All of them used these large drums to send messages from village to village and even to hunters and workers out in the forest. We saw them everywhere, heard them booming at night, sometimes with regular rhythm indicating that a dance was in progress, at other times with short periods of irregular pounding that were just as plainly serving the purpose of telephone messages.

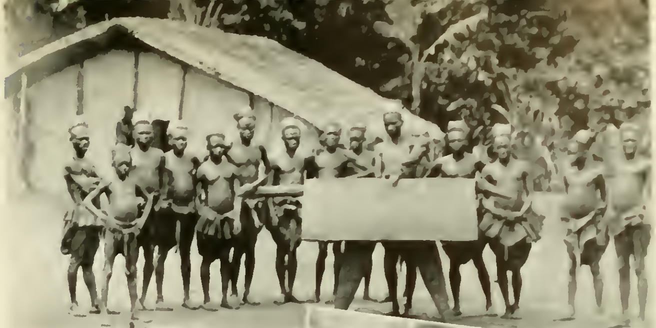
Every native chief of any account had one or more of these drums, each hewn from a single section of a great hardwood tree. The upper half had been hollowed out through a rather narrow slot along its gabled top; the lower half was largely cut away, leaving four solid legs for support; and at the ends were projections crudely sculptured to suggest the

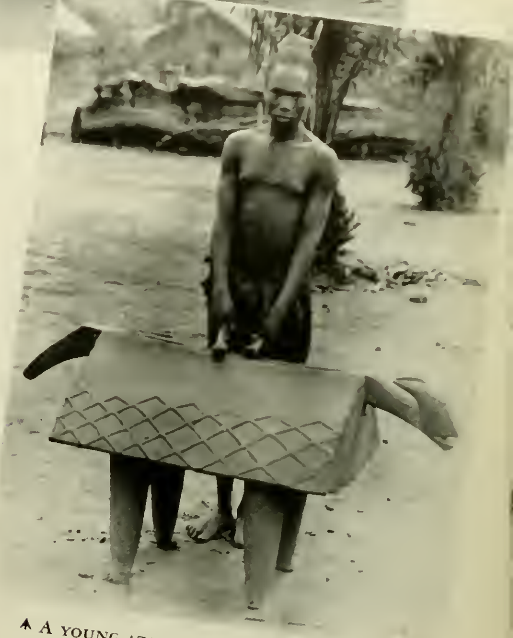


THE SIGNAL DRUM is often borrowed for dance festivals, as shown above. Note the sophisticated small boy *(foreground)* who surveys the scene knowingly, and the woman "strutting" on the right, expressing the spirit of the occasion. Dancers of both sexes wear frayed-out green banana leaves. This is in the northern Congo forest

◄ **THE AUTHOR** demonstrating the use of a smaller signal drum before the microphone in one of the American Museum's educational broadcasts. This drum is artistically carved to represent a buffalo, with geometric patterns decorating the sides in low relief

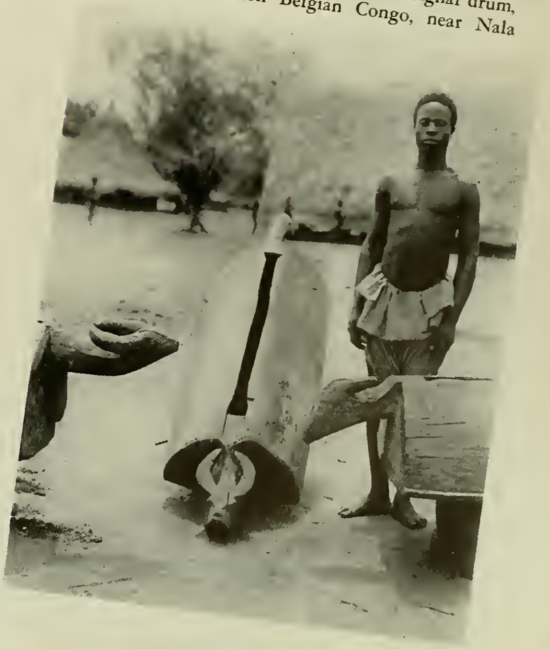
► **A GROUP** of young Mangbetus standing by the signal drum of Chief Danga, near the post of Rungu

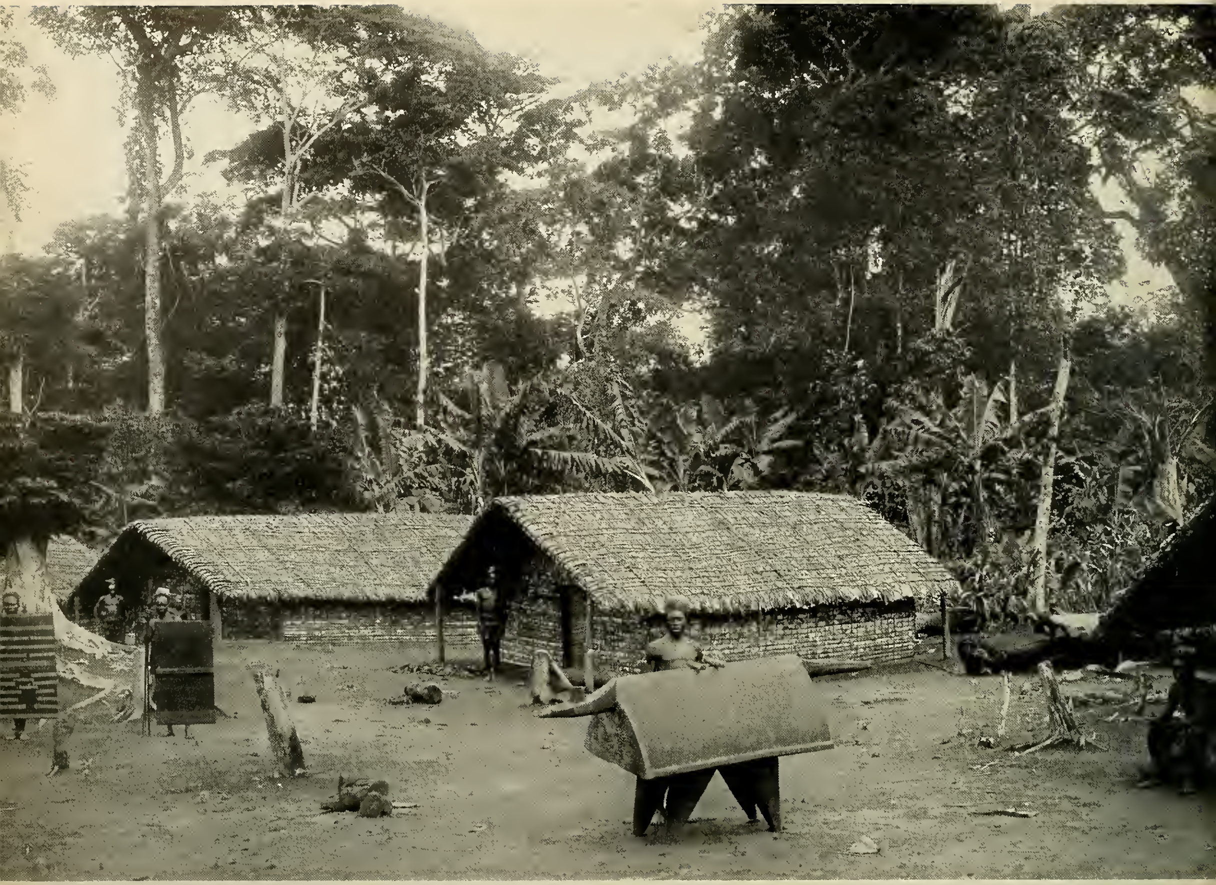




▲ **A YOUNG AZANDE MAN** with a signal drum, in the northern Belgian Congo, near Nala

► **BUFFALO HEADS** form a favorite motif in the carving of signal drums in this region. These are in the village of Chief Bafuka, an important head man of the Azande tribe, in the northern grasslands of the Belgian Congo

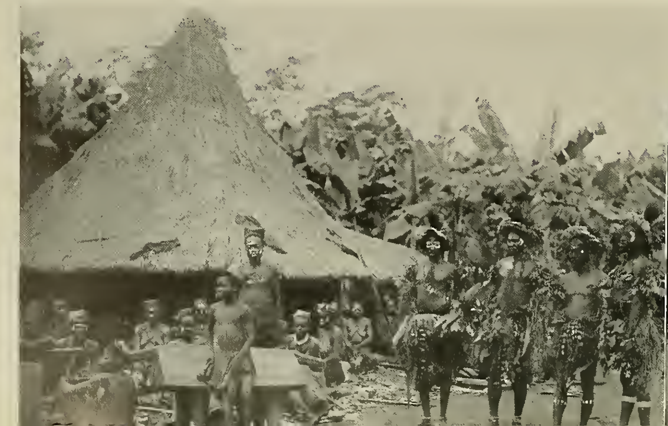




THIS SCENE in the village of a Mangbetu chief by the name of Niapu shows the customary signal drum in a prominent position. Note the two warriors standing with their spears and large wooden shields. The village is located just within the northern border of the Congo forest, near Rungu

▼ HERE AGAIN the signal drum is being used to beat a dance rhythm. Lumps of crude rubber cover the ends of the drumsticks, which are wielded by a small boy. The dancers are adorned with leaves and wear skins of genet-cats about their waists. Small iron bells jingle at their ankles

▼ ON THE TOP DECK of a Congo River steamer, a detachment of Congo soldiers receive their weekly ration of *kwanga,* manioc bread wrapped in green leaves (July, 1909). At right is Agent Militaire Guyon, who helped Lang and Chapin procure the drum for the American Museum



head and tail of a buffalo. These extremities served as handles for moving the drum about.

To transport such a specimen all the way to the Congo River where it could be placed on a steamer presented a serious problem. But we wanted one. The trouble was that the chiefs wanted them, too, and for months none would consent to part with his.

Two years had not elapsed since Belgium had taken over the Congo Free State. No money was yet in circulation among the natives in that northeastern section of the Belgian Congo, and all efforts to barter for a large signal drum failed. Taxes were still being collected in wild rubber—one kilogram per month from each able-bodied man in the region—, and as encouragement he was given trade goods valued at 75 centimes for each kilogram.

The post of Medje had two lesser stations dependent on it, Pawa and Babonde. In each of these lived a single European, whose main duties were to preserve order and collect the taxes. In charge at Pawa was Ario Guyon, Italian noncommissioned officer who had taken service in the Congo Free State a few years before, a big strong man and very bald. He was a braggart, a great drinker of palm wine when there was nothing stronger to be had, and proud of the many baskets of rubber delivered to him at the end of every month. "The King of the Mabudu," he would often call himself.

It must be admitted that willful men of his type often enjoyed greater respect from the native than we would accord them. Guyon's small detachment of native soldiers were rather proud of him, and when we visited Pawa we found it a small but well-ordered station.

We had first met Agent Militaire Guyon more than a year earlier, when he boarded our steamer at Irebu, a military training camp on the Congo just below Coquilhatville. He was taking a company of native soldiers up to Bumba. At that time he seemed on his good behavior and did not even touch the red wine served at the table. It was then or a little later that I heard a rumor to the effect that Guyon had once been accused of shooting one of his own soldiers, though he escaped conviction. That was in the Uele, and the accuser was a missionary. Now Guyon was to go back to the northern Ituri, where as yet there were no missions.

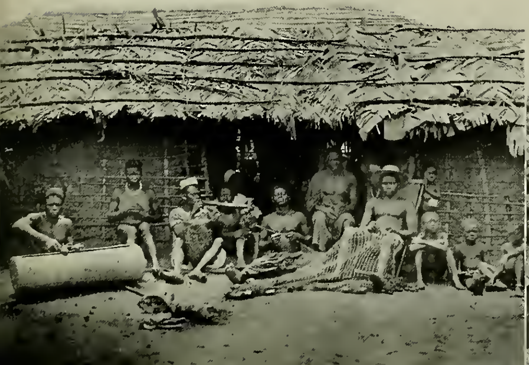
After we left Pawa our stay in the north, among the Mangbetu and other tribes of the Uele district, lasted much longer than expected. We had ample time to see many more signal drums, but none that we could readily have acquired. Moreover, Guyon wrote us that he had the one he had promised, a huge one, fashioned by men of the Mabudu chief, Abiengama. It was standing under a grass-thatched shed at Pawa, and was used to broadcast the time when each monthly tax in rubber fell due. No doubt it also served to tell the neighboring chiefs when rations were desired for the soldiers and workmen at the post, when porters were needed for transport on the roads, or a dozen chickens for the Chef de Poste's table.

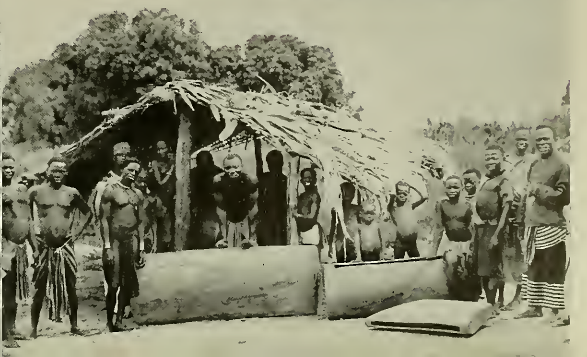
When I finally returned to get the drum, more than two years had passed, the tax in rubber had been abolished, and Guyon had departed. The drum still stood under its shed, and as I looked at it I felt two very different emotions. It would make a splendid exhibit in the Museum, but what sweat and toil would be required to get it to Stanleyville! When

➤ A MABUDU CHIEF near Pawa, where Agent Militaire Guyon was the sole white representative of European authority

(Below, left) A VILLAGE scene near Stanleyville. One man mends a fishnet, another sucks on his big tobacco pipe, while a third shows how the signal drum is beaten. Here the slot-drum retains the form of a tree trunk. But it serves the same purpose as elsewhere, passing news from village to village or out to fishermen in canoes on the river

(Below, right) TWO CYLINDRICAL signal drums and another flat wooden drum in a riverside village of the Wagenia, near Stanleyville. The palm-thatched shed serves as a loafing place or "club" for the men during the daytime and gives shelter to the drums during rainstorms





we lashed two long poles to its sides we found that it would need two relays of eight porters each to get it over the hilly country and down to the Ituri River, where perhaps a dugout canoe might be found to hold it. This was in 1913, and the carriers would be paid in Congo francs and centimes, a little over ten American cents per day each.

I already had a caravan of 60 porters traveling with me, and the drum could never keep up with them. So I went on to Avakubi on the Ituri, and arranged for one of our workmen, Gadangwa, to follow later with sixteen men bearing the drum. It makes me wince still to think of the hard work they had getting their heavy burden over the hills near Manamama, along a "road" that had never been traversed by a cart and which was little more than a wood-path with the underbrush cleared out along its sides.

It was many weeks later when Gadangwa arrived in Avakubi, to tell me that our drum was standing in the resthouse at Bosobangi, one day's march down the river at the foot of some bad rapids. I went there to arrange for its transport down the river, to Banalia on the Aruwimi, thence overland to Bengamisa, and finally by canoe to Stanleyville. The largest dugout available at Bosobangi was not quite as wide as the drum, so its edges had to rest on the gunwales, and off went our treasure on the next watery stretch of its journey toward America. The canoe looked top-heavy, and there were plenty of rapids ahead, but the boatmen of the Aruwimi are experts.

My next meeting with the drum was in a large government warehouse at Stanleyville, still more than 1000 miles from the mouth of the Congo, where all the collections I had been sending ahead by road and by canoe were stored for us. Now it was October of 1914, the first World War was on. Troops and munitions were streaming through Stanleyville toward the Kivu and Tanganyika fronts, under attack from German East Africa.

The drum had to be crated. One leg was cracked, but otherwise all was in perfect condition. A part of the lumber that had been shipped out for our final packing was ruined by termites, but Lang was a Hercules at packing, and I tried to do my bit. Finally in December I was instructed to accompany the first shipment of boxes destined for New York and left for the Lower Congo on the freight steamer *Roi Albert*. I do not recall whether the drum was in this first shipment, but all our collections got home by much the same route.

The German occupation of Belgium had disrupted steamer service from Europe. I waited a month at Boma on the Lower Congo and was fortunate to obtain passage on the first steamship that called there in 1915, the *Bornu*. Our ship, with those precious collections aboard, was bound for Liverpool. At the second port of call, Libreville in the Gabun, we learned that the Germans had declared a blockade of Britain, to be enforced by submarines.

There was, of course, no possibility of turning back or of transshipping my cargo. Indeed, all the collections of our Congo Expedition had to find their way home by way of England through the submarine blockade. The *Bornu* was a slow little freighter, with cabins for a dozen passengers and a maximum speed of about twelve knots. She picked up a cargo of lumber, palm oil, and palm kernels at a succession of ports along the African coast, delivered bags of kola nuts at Dakar, tarried a day in the Canary Islands and sailed unarmed up the Irish Sea in broad daylight, an easy prey to a submarine if luck had not been with her. Safe in Liverpool, six long weeks after leaving the Congo, I thanked heaven and made arrangements to have my freight taken to New York by the American Line.

The drum, I regret to say, now has some initials of New York boys carved on it. Little do they dream of the story behind the drum, its makers, its travels, its escape. But most tragic of all was the story of Guyon himself.

As I mentioned, he had left Pawa, and I heard no more of him till I was about to start down the Congo River. Then it was reported that he was again stationed at Coquilhatville, so when the steamer stopped there I stepped ashore to look him up. To my surprise I encountered Major Krüger, another old acquaintance in the region of the Medje. I asked him if he knew where I could find Guyon.

"Yes, he is here," I was told, "but you won't see him. Not long ago he was playing cards with a few of his friends. They had been drinking. Guyon angrily accused one of the players of cheating, seized an Albini rifle, and shot him. Luckily the victim is now recovering, but you can't see Guyon, he is in jail."

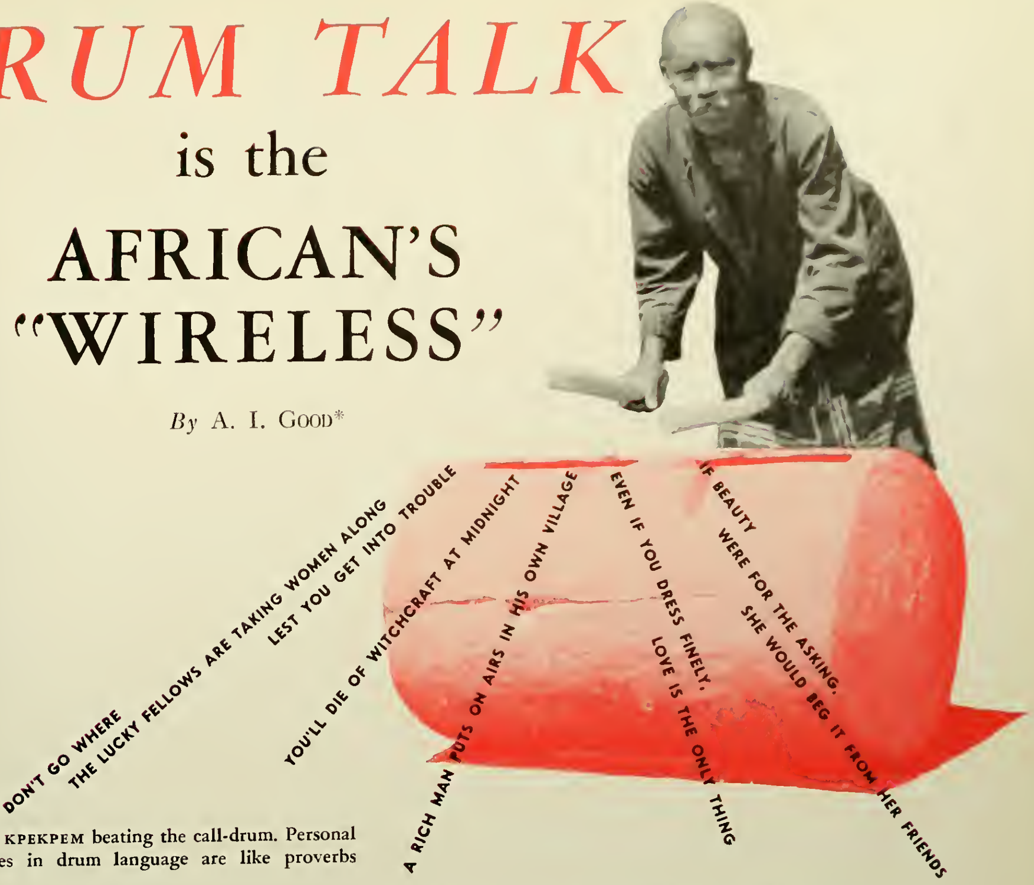
That was certainly the end of his career in the Congo, but looking at the drum I shall always recall its history and wonder what message a Mabudu drummer might have pounded out of it to broadcast the sad fate of the "King of the Mabudu."

Africa is now shaken by another world conflict. But it is a different Africa from the one we explored in those earlier days. Many of the old trails have been supplanted by modern highways, and over and above the magic beat of the talking drum echoing through the virgin forests, radio waves carry their other messages back and forth across the continent, presaging we know not what.

But lest an ancient art be lost, let us not forget the marvelous system of communication invented by the natives of "Darkest Africa." These people had no written language; handwriting was utterly beyond them. Yet they devised an ingenious method of making a drum "speak" for them, so that they could send almost any message they wished and over considerable distances by means of relays. No other primitive people outside of Africa ever developed so fine a system of transmitting thought through space. In the eastern Congo innumerable tales used to be told of how news of the coming of some European would arrive a day or two ahead of him, giving his identity, the number of soldiers or porters accompanying him, and the purpose of his visit. Most of the popular accounts in books of travel are superficial and inaccurate, while the few good discussions, chiefly in German and French, are hidden away in technical journals. So for the explanation of drum talk I turn you over to another old friend of mine, Dr. A. I. Good, who will tell you in the article following this one what he has learned of it over a period of many years spent in French West Africa.

DRUM TALK is the AFRICAN'S "WIRELESS"

By A. I. Good*


DON'T GO WHERE
THE LUCKY FELLOWS ARE TAKING WOMEN ALONG
LEST YOU GET INTO TROUBLE
YOU'LL DIE OF WITCHCRAFT AT MIDNIGHT
A RICH MAN PUTS ON AIRS IN HIS OWN VILLAGE
EVEN IF YOU DRESS FINELY,
LOVE IS THE ONLY THING
F BEAUTY
WERE FOR THE ASKING,
SHE WOULD BEG IT FROM HER FRIENDS

Old kpekpem beating the call-drum. Personal names in drum language are like proverbs

How the black man was able to send out his messages of joy or sorrow over jungle and valley long before the white man invented the radio

The log is expertly hollowed out until the curved sides are only about half an inch thick and give different tones

Listen to that drum beating in a town a mile away. "Tap-tap-tap-tapping, tap̆-tapping-tap-ping-tap!" How clearly the beats sound out over the forest. How exactly the call is repeated, its tempo the same every time, every pause in precisely the same place. But wait, it changes, and now goes "Tap-tap-tap, tapping! Tap-tap-tap, tapping! Tap-tapping, tap-tapping!"

You ask your native companion, "What is that drum saying?"

He looks sheepish, but answers, "Man call chief come quick, say white man come." It is all a mystery to you; but 20 minutes later, when you arrive in the town, the chief is there waiting with a present of two eggs for the white man. You decide there is something to this drum business.

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* Dr. A. I. Good has lived in West Africa for many years as a missionary in a region pioneered by his father. His observations on the native "drum-talk" in the sections where he has traveled enable him to write the first popular article on the subject ever published in an American magazine.

Could you hear and interpret those beats of the drum as can your black companion, you would know that the first series was the individual drum-name of the chief, rendered as follows in the Bulu language of South Cameroun: *"Kup te mfañ étom, be limeti kupe tyiñ."* This was repeated several times to get his attention. Then followed the phrase, also repeated, *"A wôé bôt élañ,"* the general drum-name for a white man, and not very complimentary. Then the words *"Za' avô, za' avô,"* meaning "come quickly, come quickly." The chief, off in his garden, understood that he was being called because a white man was coming. So he returned at once and played safe by getting ready a small present.

The black man's wireless telegraph

Long before white men came to Africa—how long ago no one knows—the black man had developed his own peculiar system of wireless communication.

He needed it, for in the heart of the tropics the country is one vast unbroken forest. Roads were nonexistent, only footpaths traversed the jungle. Men went far into the forest to hunt. Women traveled long distances to their garden-clearings. If something happened in town, how could they be informed? An important man died, his funeral was a major event in the primitive community; how was word to be spread? A man's wife ran away; how could he tell the people along her path to catch and hold her?

Sickness, death, war, hunting, fishing, all are of prime importance to the savage. The practical answer to all these needs is the drum. In many parts of West Africa these wooden drums are also known as "gongs." Messages beaten on the drum could call individuals miles away in the forest or broadcast news to distant villages. By relaying it from town to town a large area could soon be apprised of news vital to all. Though the white man has in recent years perfected his wireless to cover thousands of miles, remember that the primitive African savage invented his "wireless" long before a European ever thought of it.

How far?

An ordinary drum can be heard easily in the daytime at three or four miles. In the dead of night the best drums carry ten or even fifteen miles out over the forest. I knew of one exceptional drum that has been heard 25 miles, though its message could no longer be understood. Three factors, in the main, determine the range: the size of the drum, its individual quality, and the type of country.

Medium-sized drums carry farther than the very small or the exceptionally large. Individual instruments differ widely in resonance, because of the kind of wood used, or even more as a result of construction. A good drum-maker becomes widely known. In certain sections the topography is of importance, long valleys or river courses aiding transmission in their direction. The range of any given drum therefore varies greatly.

The Bulu, together with the Yaoundé, Bene, Ntum, Okak, and some other peoples, are all part of the great Fang tribe which extends clear to the Ogowé River in French Gabun. While each of the lesser groups has developed dialectic differences, the whole Fang language is basically one. Any one of the dialects would be understood wherever Fang is spoken. Fang belongs in turn to that great language family known as Bantu, which extends all across equatorial Africa, and south nearly to the Cape.

It is true that the drums vary in form over the vast expanse of Africa in which they are used to send messages. Certainly also the drum-calls differ between distinct languages, for phrases from the language in use are beaten on the drum. We venture to assert, however, that the basis of message transmission by drum is the same wherever the system is used. In this article we shall confine ourselves to the drums and drum-calls of the Bulu people, with which we are familiar.

The call-drum is a hollowed log of wood. Some three kinds of hardwood trees are used by the Bulu for making it. The *mbel* tree, or barwood (*Pterocarpus osun,* of the family Leguminosae), is often employed, as is also the *ebae* (probably *Pentaclethra macrophylla,* of the family Mimosaceae). The latter is acacia-like, bearing large pods. Another hardwood tree with thorny bark, the *olom* or *ololom,* is equally good.

A small drum will require perhaps a two-foot section of log, while a large one may reach a length of three and a half or four feet. The log is hollowed out roughly through a longitudinal slit while still lying in the forest. The slit is three or four inches across, and runs nearly the whole length of the log. After its weight has thus been reduced, the log is slung on a pole, brought into the village, and the finishing touches are then added. The sides are carefully hollowed to the required thinness and smoothed off, by the use of a chisel-like tool inserted always through the same slit. The curved walls of the finished drum will be but a half-inch or less in thickness, the ends being left two or three inches thick. This makes a hollow cylinder with closed ends, highly resonant when dry, the only opening being the slit along the top.

When the slit is first made, a small section of wood is left connecting its opposite edges, a little to the left of the exact middle. This is known in the Bulu tongue as the *otat,* or crier. Later the small section is separated into two blocks of different size, each adhering to its side of the slit, separated from the other by a crack one-quarter inch wide. One, known as the "man," is nearly twice as broad as its mate, called the "woman."

When I inquired why these blocks are situated to the left of the middle, the answers, though indefinite, were to the effect that if they were right in the center the tones would be somewhat jumbled, or muffled. If slightly off-center, the tones of the drum would be clear. Possibly it is a matter of overtones, not understood but learned by experience.

There are two drumsticks about a foot long, one for each hand. The best are sections of the midrib of the frond of a palm, *Raphia vinifera,* the flatter lower side being struck against the drum. Rounded sticks may also be made from the soft, light wood of the common umbrella tree, *Musanga Smithii,* called by the Bulu *aseng*. They may be of equally soft white wood from the *avom* vine or tree, a member of the family Anonaceae, probably *Cleistopholis Staudtii*. Harder woods wear away the lip of the drum too quickly. It is beaten on the edges of the slit, just on each side of the "man" and "woman" blocks, the drummer standing on the "woman" side.

To secure the best resonance and carrying power, the drum should be supported on ropes roughly woven from the outer fibers of plantain or banana plants, or from the dried fronds of the same plants, upheld by a frame of forked sticks driven into the ground. A small thatched roof may be built over it for protection from sun and rain, and a piece of bark laid over the slit. The drumsticks are usually kept in the cavity of the drum. At the close of a drum-call the thump of the sticks as they are dropped in is characteristic. For a small drum the special support is not worth while. It is kept in the palaver house of the chief, to be carried out and laid on the ground as needed.

The basis of message transmission is tone. Many of the Bantu languages are "tonal" in character. To be properly spoken, they require that each word be pronounced in its correct tone. There are five different tones in the Bulu language, but most words are either in the two lowest tones of the register, which are not far apart, or in the two highest ones, likewise close to each other. The middle tone is used with relatively few words, and so is practically negligible. Roughly speaking nearly all words can be classed as high or low; this two-tone division is the basis of the drum-language.

The two sides of the drum, chiefly because of the difference in thickness and also because of the two blocks of wood unlike in size—the "man" and "woman"—produce two distinct tones, one considerably higher than the other. These high and low drum tones can be made to correspond to the high or low tones of the language, by striking on the appropriate side of the slit. Thus the tones of the message are beaten on the drum, and the hearer reads them back into the original words. The meaning becomes clear.

It would seem that the two blocks within the slit are not essential. When the drum becomes worn, and the blocks break off, the tones continue to be separable, even though less clear. Recently I have seen a large drum where the "man" and "woman" blocks were on the wrong sides with reference to the tones. Evidently the maker had made a mistake but had compensated for it in the thickness of the drum-walls. The tones were still clearly separate, though in this case the "woman" block was on the low-tone side, the "man" on the high-tone. The thickness of the walls is most important, and I have known a man, as he was making final adjustments, to chisel off a little wood from one inner side, and then to tap it to get the tone. He was tuning his drum as the piano tuner makes the adjustment of a string.

This use of the tone of words for the words themselves explains the ability of natives to understand one another when calling at great distances. They are not hearing actual words, but rather a series of tones. In fact the Bulu sometimes employ a language, if so it may be called, of pure tone without words, to which they give the name *kili*. Individuals too far apart to hear actual words call back and forth using only the syllables "ki-ki" in the tones of the words they would employ in ordinary conversation. Short sentences are transmitted and understood. This I have watched many times, and the principle is the same as that of the drum-language.

Drum-calls are in a sort of code. In sending messages on the drum the operator does not choose any sentence at random. There are a large number of fixed expressions, either drum-names of persons or drum-sentences conveying certain ideas. The sentences have a literal meaning, but this may not be their true significance for the message. We sometimes cable a ten-letter code word of jumbled letters, or else a ten-letter word that means something; either will work, the message is to be found in the code. Accordingly, "a hill is a great thing" is a logical statement, but its real message is that a man otherwise known as Ndongo is being called. "Only folds folds hands [on] breast" may convey an idea, but it really means, "He is dead." However many ways there are of saying this in ordinary speech, on the drum there is only one, a code sentence intelligible to drummer and hearers.

These fixed code sentences are beaten on the drum, and the listeners, from the tones alone or perhaps with the aid also of the rhythm of the sentence, can decode the message again so as to seize its true meaning. The rhythm of the code sentence is the same as it would be if spoken rapidly with heavier stress on one word than on another, or on some syllable of a word. But I could detect no rhythm peculiar to the drum; and the tones, I believe, are the most important element in the recognition of the sentence.

We can understand why many young natives, these days, can neither beat the drum properly nor interpret its voice, for they have not learned the fixed sentences. Likewise the white man can scarcely become proficient in understanding them, because he must have perfect command of the language and its tonal qualities. But the native ear can, with proper training, translate the tones of the drum into the words that correspond. It takes considerable practice for a white man to recognize his own drum-name, if he has been given one.

Examples of drum-calls

Every man and most women used to have an individual drum-name, a fixed code sentence. Sometimes it seemed to have no particular meaning. In other cases it seemed to refer to one's character or some other circumstances. My father, Dr. A. C. Good, the first white man in South Cameroun, was continually traveling hither and yon in preliminary explorations. He was given this very significant drum-name by the Bulu: "Going, going, going, what are you going to look for?" The writer's drum-name was given by some old men, probably because he is an only child: "You walk alone, where are your brothers?" Women might have names referring to them as superlatively beautiful, or occasionally the opposite. Sometimes the names were handed down to younger members of a family as their elders died off. A man when asked recently his wife's drum-name replied: "No. I tried to give her one, but she wouldn't accept it, and her own family never gave her one." She must have felt that her own family should have provided it. If you were named for a certain person, you might take the same drum-name.

Code sentences serving as names are usually short, very idiomatic, and difficult of exact translation. They employ a negative form which seems ancient and is employed only in proverbs and drum-messages. With the advent of European civilization and education many old native customs are disappearing, and with them the drum-calls. The younger generation neglects the drum and consequently does not possess drum-names. As the older generation passes, first-class drummers become scarce, and it is mostly the elders who can still interpret the calls. Eventually the art may disappear.

A few examples of drum-names, translated into English, are these:

"The giant wood rat has no child, the house rat has no child."

"A witch does not eat fruit, but any man eats [it]."

"A rich man puts on airs in his own village."

"Take care of the ground, that it is which will bury you."

"Oyono must not join the fighting, I don't want Oyono to die."

"The chameleon does not shoot a gun, does not shoot a bow, what is he creeping up on?"

The stealthy gait of a chameleon as it prepares to shoot an insect with its tongue is well known. Other names refer to the francolin scratching in the forest, or the parrot raiding palms for their fruit.

Some drum-names can belong only to women:

"Even if you dress up finely, love is the only thing."

"She is better than the daughter of other tribes, she who stands there."

"If beauty were for the asking, she would have begged it from her friends."

"Fine walking without the sound of a footfall."

"The village of the rich man [or polygamist] is not without its treasure."

"She stands as Tolo stands."

Tolo is a five-star constellation, admired by the Bulu. As it stands above other stars, so she surpasses other women. The terse tonality and idiomatic brevity are lost when such names are rendered in English.

Other messages sent on the drum

Aside from drum-names, the actual messages beaten on the drum are surprisingly few—in the Bulu country at least—and limited to certain essential information. Food is very important. Suppose a man returns unexpectedly from a journey or from hunting, only to find his wife absent in her garden off in the forest. He is hungry and may call her in this manner: *first,* her drum-name; *second,* his drum-name; *third,* the message as follows:

Za'a w'awulu avô, avô, m'awô'ô zaé te ngelé.

"Come walk quickly, quickly. I feel hunger not small."

If a man is very sick, after his name comes:

A nto ane jomolo, jomolo.

"He is as weakening, weakening."

If he has died:

Ve ba'a ba'a mo tôé.

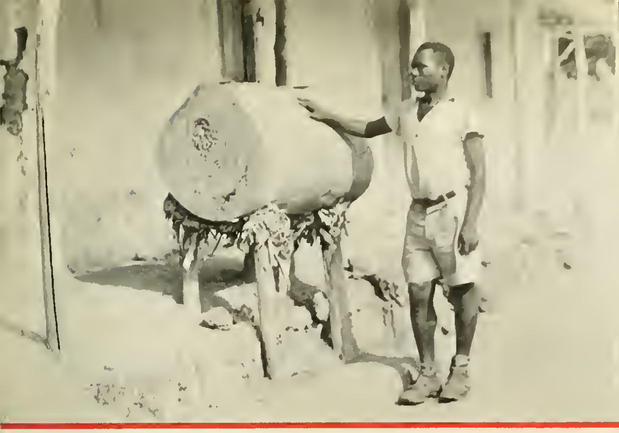
"Only folds folds hands [on] breast."

To call people to go hunting in the forest with nets into which the game is driven:

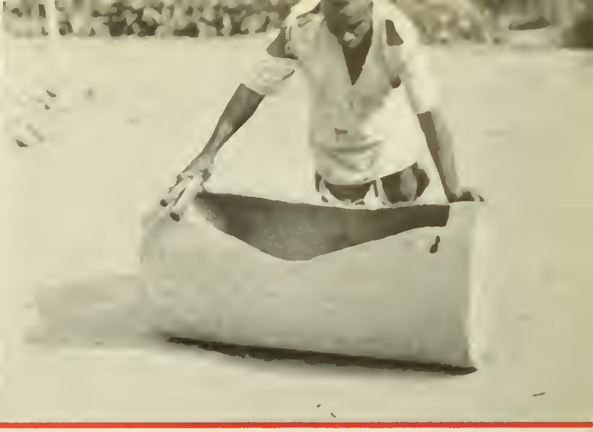
Okpweñ ô nto ngata'a ne doé, doé, doé.

"Little antelope is tied up tight, tight, tight."

A CHARACTERISTIC village in the Cameroun. On the left is a drying-rack for cocoa, the chief product of the country. Beyond it are oil palms and a sheep wandering across the street. Behind the houses begins the forest



Dried banana leaves serve as a buffer between this drum and its mounting, that it may not lose its resonance. It rests just under the eaves for protection from rain



This poor old drum has lost its resonance and will no longer carry any distance. But the two tones can still be differentiated, which explains why it was used so long

Four villagers. Their names: "You are overcome with greediness, just as they were about to hand it [food] to you," "Tied up, tied up tight! Tied up, tied up, loosened," "Don't go where the lucky fellows are taking women along lest you get in trouble," and "You'll die of witchcraft at midnight"

In or out of the palaver house, the drum is a convenient seat. The very small child far down the village street is an albino native.

Though the grand masters are growing scarce, it is to be hoped that the new generation will preserve the unique art of drum talk

If a woman runs away from her husband into the forest, the drum may warn others to watch and catch her:

Fé kpwabak! kpwabak!

"[Into the] bush, crash! crash!"

When a white official is coming, the drum says:

A wôé bôt élañ.

"He kills people [with] malice."

This general drum-name for a government official comes down from earlier days, when this part of Africa had to be ruled with a stern hand.

In order to warn people to kill a leopard that someone had sighted, the drum would signal:

Môt a nkele nda, ve atan, atan.

"Person he not go [in] house, but outside, outside."

A man far off in the forest might be called home as follows:

Beyeñ be nto wo jal nne, za'a wulu avô.

"Guests they are you village here, come walk quickly."

In the old days a wrestling match was a tribal contest of great excitement, but the custom died out because of governmental disapproval. The matches often led to blows or even bloodshed. The invitation used to go out over the forest:

Bulu Bulu ngam, Fañ Fañ ngam.

"Bulu Bulu on one side, Fang Fang on one side."

During the match there was always plenty of drumming, for no African assembly is truly happy without a maximum of noise. There were dance-drums made of a hollow log four feet long and covered with antelope skin. These were beaten with the hands only. The call-drums were then used mainly to accompany the dance-drums, not issuing any message. But in the hands of a skillful operator, the call-drum could be used to encourage one of the wrestlers, to warn him of a coming hold, or to advise him to take advantage of an opening. Coaching from the side lines is far older than American baseball.

At dances the call-drum is commonly employed for the same purpose as other types of drums, to beat the time. But it can also advise a special dancer, if need be, to stand up, sit down, come out, turn his back so, or stoop forward.

The actual messages that are usually transmitted by drum in the Bulu country by code sentences scarcely exceed a round dozen. The use of other than such fixed sentences would throw the listener into the mass of tones of general speech and result only in confusion. Remember that the hearer of a distant drum-call has nothing to work with but the two tones and their rhythm.

We might illustrate how the tone pattern of a drum-call is beaten as follows, using the upper level to show the syllables beaten on the "woman" side of the drum, and the lower level to show those on the "man" side:

Kup be li-me-ti kup tyiñ.
te mfañ é-tom,

"The chicken has no real guilt, yet they wring its neck."

tam, be- be
W'a-wul' é- bo- nyoñ né?

"You walk alone, where are your brothers?"

The advice commonly given to drummers is as follows: Don't lean over the drum, but straighten up, or its sound will be muffled. Look in the direction you wish the sound to go. Don't hold your arms against your body, spread them out, and the sound will carry farther. A good drummer must not eat chicken wings, give them to someone else. The flapping of a chicken's wings does not sound far, they won't help.

Present uses of the drum

In olden days the drum was of great service, especially to call the people together to "talk palavers," or discuss topics of general importance and cases at law. Most of these had to do with property rights in women. A woman was sold in marriage by her father or brother. She might die without having been fully paid for; and she bore children whose ownership could be questioned. Thus she was a chief topic of conversation and even dispute. "Palavers" about women lasted for hours.

In the quiet of evening or just before daybreak, when sound carried best, the local drummer exhibited his skill by calling the drum-names of all persons of importance in the vicinity, one after another, scores and scores. Each man listened for his own name, and felt injured if omitted from the roll call.

Nowadays the drum serves instead of a bell for the various missions, Protestant and Catholic. Every village chapel has its drum; and the drummer calls the roll of drum-names as an invitation to the services, thus helping to preserve the art as its older uses dwindle.

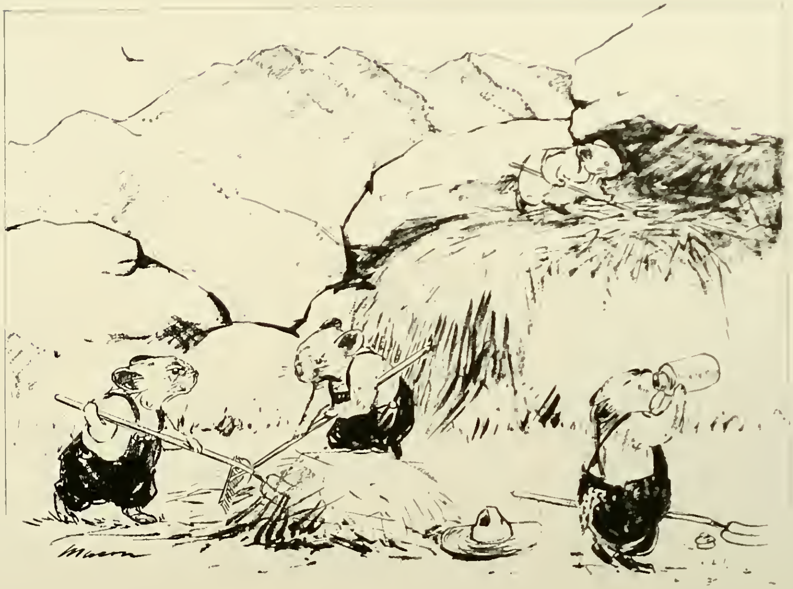
Before a recent Sunday service, I took down a list of 52 drum-names, with the help of three or four men who knew drum-calls. We sat in a house, out of sight of the excellent drummer; and the men gave me each sentence before the next started, sometimes even before it was quite complete. Without their knowing what might come next, they amazed me by identifying every call within five to ten seconds. They probably knew 200 and more such names.

It was hard for me to write down enough of each name-sentence to be able to complete it later. At the end of 20 minutes I stopped the drummer, who could have continued. Later in the day a near-by chief asked who beat the drum that morning. He had noticed the difference between an expert and the indifferent drummer who usually performed.

It works

A year or so ago I stopped in a Bulu village where a man lived whom I wished to see. But the man had been off in the forest for hours, at work in his garden. It would have taken an hour for someone to walk there and bring him back, so I asked if he could be called with the drum. A little drum was brought out from the palaver house, and the tap-tap-tap went out on the air. I waited. In a half-hour, almost to the minute, in he came. "I heard you called me," he said. "what is it you want?" The drum certainly can talk.

THE PIKA HARVESTERS



By JOHN ERIC HILL
Drawn by
G. FREDERICK MASON

IT IS strange that any close relative of the rabbit should store food against hard times; because the rabbit himself is quite careless in such matters and lives a life as free from industry as the cricket in the fable. But the pikas live where the deep snows of winter cover all their food; and since they do not hibernate, they would starve if they did not store provisions.

These small mammals, which are also called conies or rock-rabbits, live in the western mountains from central Alaska to the Sierra Nevadas of California and to northern New Mexico. They make their homes in masses of broken rock, generally on the higher peaks near timberline, but where conditions are suitable they may be found much lower. Often the first signs of their presence are the little piles of hay, under and between the rocks. If one should wait quietly a gray, tailless mammal, slightly larger than a guinea-pig may slip noiselessly to the top of a boulder and utter a clear, squeaking "bleat," which once heard is unforgettable. If the pika has not been seen moving (and they move very quickly and then freeze for a few seconds), the little bleater is hard to locate; the sound seems to come first from one place, then from another. Pikas are timid, as they may well be with so many predaceous birds and mammals as enemies, but they are full of curiosity and if not molested they often ignore the presence of a person watching them.

During the early summer these rock-rabbits take life easily, but with the first frosty nights the old pikas become serious harvesters. All day long they travel back and forth from the rock pile, their home, to the weed patches or grassy slopes near-by. They nip off grasses and the leaves and green parts of food plants, and fill their mouths with bulky masses of the material. Sometimes a load may be almost as large as the little harvester's body, and their activities present an interesting scene as they scamper surefootedly over and under the rocks to one of their haystacks. A large pile may contain a bushel or more of the dried and drying hay, and they often use the same places to pile the hay year after year.

Then during the winter the pikas slip through their blacked-out galleries of rock and dine upon their stores of dried food. When spring comes again to the highlands, little remains of the haystacks but the woody parts of food plants that have been rejected.

Pikas are also found in Asia, east of the Ural Mountains. They have much the appearance of the "conies" mentioned in the Bible, but the latter, which can still be seen in the Near East, are different in skull and teeth, and are more properly called hyraxes.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Fall, 1942.

•

SUNDAYS over the Mutual Broadcasting System (WOR) from 9:30 to 10:00 A. M.

This Wonderful World. Quiz program, with young people answering questions on nature subjects.

•

WEDNESDAYS over WNYC from 3:30 to 3:45 P. M.

Science For the Seven Million.

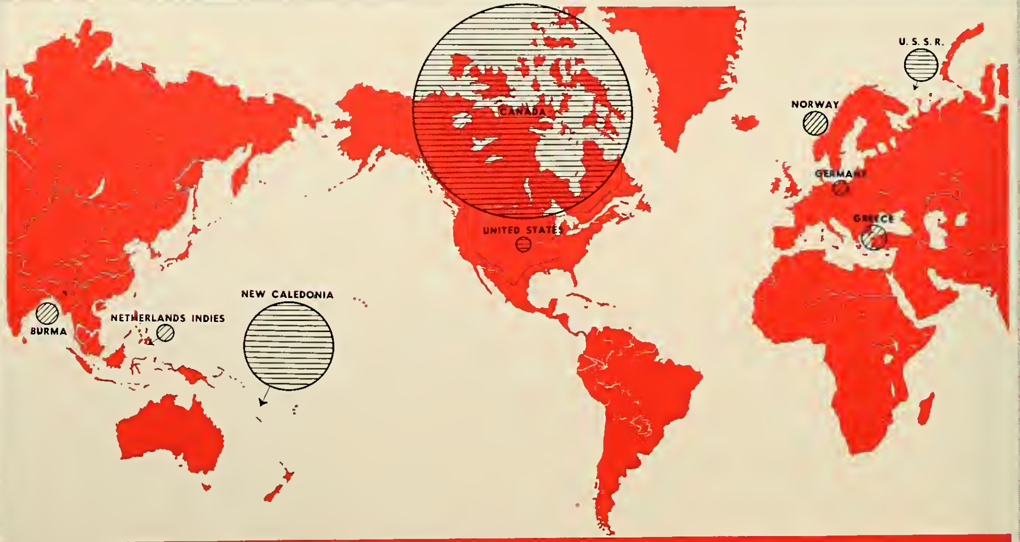
•

FRIDAYS over the Columbia Broadcasting System from 4:30 to 4:45 P. M.

Exploring Space. Science in the sky.

STRATEGIC METALS

NUMBER VII



Production under 500 tons annually not shown

Production of NICKEL

▤ Controlled by United Nations ▨ Controlled by Axis

1940 figures where available, otherwise 1938 or 1939

Shortage of nickel impairs the strength of all armor and machinery and can even cause steel parts to snap in winter weather

By FREDERICK H. POUGH

Chairman and Acting Curator
Geology and Mineralogy,
The American Museum of Natural History

NICKEL is second only to manganese in importance in the production of armament. Its role in steel manufacture is as a toughener. It is necessary in all forms of armor plate, in all sorts of steels for machinery, and it even serves a useful function in cast irons. In addition to its toughening effect upon steel it gives other remarkable properties, such as resistance to corrosion, heat, and stress.

Although nickel is on our strategic metals list, the American people need have no fear that Allied control of the world's production will be lost, for this metal is found in great abundance not far from our borders, in Canada. The International Nickel Company has had a virtual monopoly of nickel production almost since it commenced work in 1887. The mines at Sudbury, Ontario, were opened as copper mines, but it was soon found that the nickel far overshadowed all their other products, which include gold, silver, platinum, palladium, rhodium, ruthenium, iridium, selenium, and tellurium.

The only mines of consequence outside of Canada are those in New Caledonia, in the South Pacific.

These two regions produce two vastly different, yet related types of ores. Nickel ores occur in association with what are known as basic igneous rocks. The nickel is in iron-magnesium silicates, and when these alter, as they readily do, through action of solutions as they cool, or under conditions of atmospheric weathering, they are transformed into serpentine, and the nickel has to go along. So, as iron is removed by solutions or goes into limonite formations, we get a whole series of these nickeliferous serpentines, some of which may be almost half nickel oxide. The New Caledonia mines produce this type of ore.

The Sudbury mines are similarly in basic rocks, but the exact origin of their ores is still a subject of controversy. The too simple explanation is that a vast sheet of basic magma differentiated during crystallization, permitting a series of sulphide minerals to settle to the floor of the sheet, the most abundant of which is pyrrhotite, an iron sulphide. Subsequent sinking of the rocks beneath the norite sheet developed a more or less continuous saucer-shaped deposit underlying an area 16 by 36 miles. Geologists are unhappy about so simple an explanation and keep finding evidence for new complications of subsequent intrusions, replacements, and so on. In any case, however, the nickel is clearly associated with the basic igneous rock.

Pyrrhotite is the principal ore of nickel, a sort of frustrated mineral which does not have quite enough iron

Continued on page 103

Both the animal and metal which give our "buffalo nickel" its name are identified with the North American continent. Axis nations are melting down their nickel coinage which, perhaps in anticipation of their shortage, frequently contains much more nickel than the 25% in our five-cent piece

Nickel is vital in certain corrosion resisting alloys, among them stainless steel, which gleams atop the Chrysler Building *(right)*. The ore pyrrhotite *(at bottom)* has a metallic luster when fresh but soon tarnishes, unlike the alloys it makes possible

Keystone View Co. Photo

UNITED·STATES·OF
FIVE CENTS

AMNH Photos

A *MALARIAL* Invasion fr

The dramatic story of an attack upon the western hemisphere by one of the most dangerous mosquitoes, and science's successful campaign against it

[This article is compiled from a series of accounts reporting the yearly progress against *Anopheles gambiae* in the President's Review of the work of the Rockefeller Foundation.]

If Orson Welles in his famous broadcast had announced not that the Martians had landed in New Jersey, but that a certain mosquito from Africa had arrived on the American continent, there would have been no public alarm. It is doubtful if there would have been any public interest. But the mosquito *Anopheles gambiae* is potentially a much more dangerous invader than the Martians would have been. H. G. Wells's Martians, it will be remembered, were unable to adjust themselves to life on this planet and quickly died. But when this mosquito actually did invade Brazil from Equatorial Africa in about 1930, it proceeded to make itself very much at home.

Who is this new invader of the Western Hemisphere and how did it get here? Anopheles mosquitoes are malaria carriers; the *Anopheles gambiae* is the most dangerous member of a dangerous family. It is the scourge of Central Africa, a carrier of a serious

WHERE IT GAINED ITS FOOTHOLD

◄ Accidentally carried to the New World in an airplane or fast destroyer, the mosquito that is the scourge of Central Africa found favorable breeding grounds in stagnant sunlit pools like the one at left. The wax palm, or carnauba, is typical of the landscape

om AFRICA

By RAYMOND B. FOSDICK

President, The Rockefeller Foundation

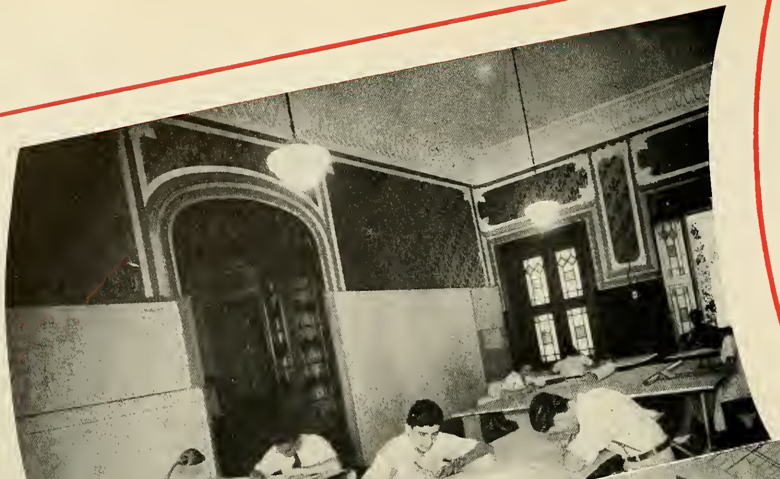
and often fatal type of malaria sometimes complicated by the so-called "black-water" fever. Its principal home is the African tropical belt, extending from the southern borders of the Sahara desert south to the Zambesi River, and it has also been reported from Algeria and Morocco, and from Southern Arabia.

A mosquito cannot fly across the Atlantic Ocean, and until 1930 this insect had never been seen in the Western Hemisphere. In that year, however, or shortly before, it crossed the ocean. It did not invade like an army; a single fertilized female may have been the cause of all the misery that followed. This tiny enemy alien was able to enter America because of modern methods of rapid intercontinental travel. An airplane, which a few hours before had received passengers in West Africa, alighted on the coast of Brazil, and when its door was opened the unwanted immigrant flew forth undetected, to begin the colonization of a new continent. Or perhaps the stowaway took passage on one of the fast French destroyers which at that time were working in connection with the French Air Lines between Dakar in West Africa and Natal in Brazil, and drifted to shore from the deck of the anchored vessel.

It was Dr. Raymond C. Shannon, a member of the Rockefeller Foundation's staff, who first discovered the insect in 1930 within the city limits of Natal, during a routine mosquito survey in connection with the Yellow Fever Service. The seriousness

◄IN THE RAINY SEASON, sluggish streams offered an extensive haven. Even a rain-filled hoofprint or wheel track was sufficient, as the gambiae mosquito takes only seven or eight days from egg to adult

►IN THE JAGUARIBE Valley over 90% of the population was afflicted in 1938. At right, an investigator against the spreading menace finds evidence of gambiae in a sugar cane irrigation ditch in this area



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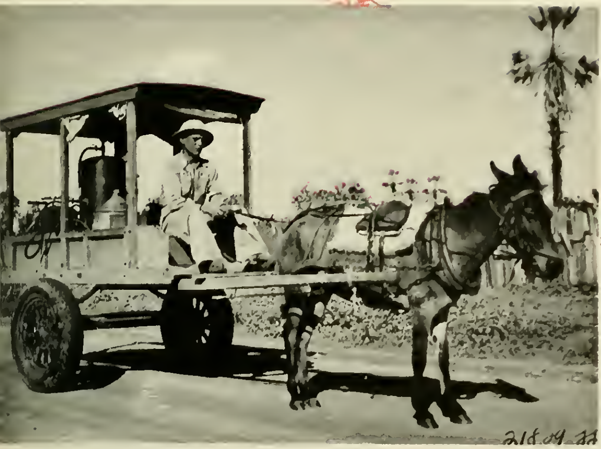

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1 MAPPING SECTION. So that no pools would be overlooked, the Rockefeller Foundation and Brazilian Government mapped the whole egion aerially

2 EXAMINING BLOOD for malaria: a view in the laboratory building vhich was the nerve center of the ampaign

3 FRONT-LINE TRENCHES in the war against gambiae were shallow litches and pools. Larvicides were prayed on every breeding place to top spread

4 AN INSPECTOR applying Paris green to a windmill-fed irrigaion canal

5 A GASOLINE-POWERED compressor for ridding houses of the nosquito

6 THE SPRAYER in operation in a typical rural home. With 12,000 square miles infested and well-watered valleys not far away, gambiae threatened to spread beyond control through South, Central, and even to North America

7 "DEATH to the last pair." Catching mosquitoes on a square umbrella

8-9 THE MOSQUITO FRONTIER: a station for disinsectizing vehicles

10 EVEN a native raft can carry larvae in its cask. But by late 1940, no gambiae were found in all Brazil

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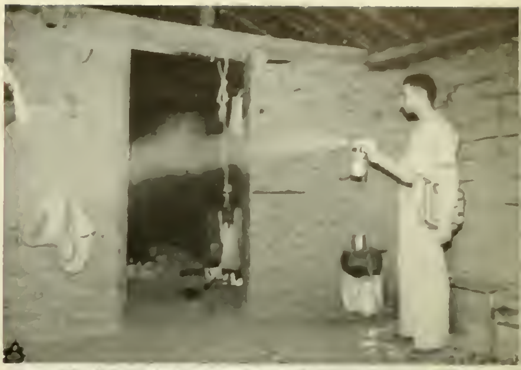

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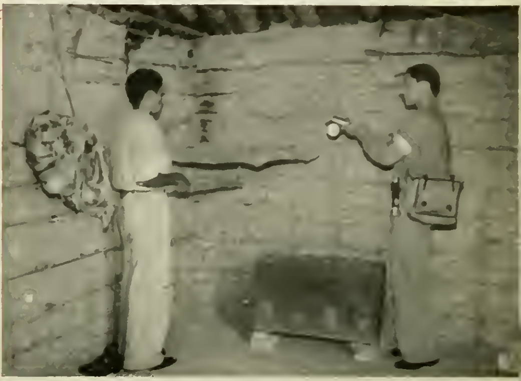

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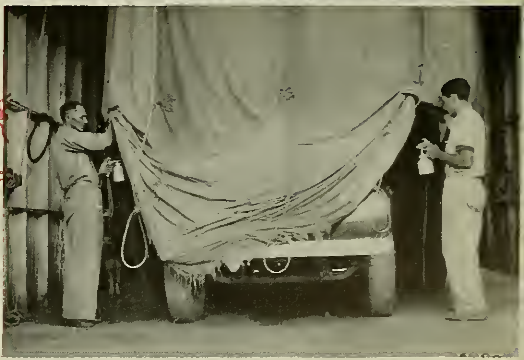

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of its presence was immediately recognized, but it was hoped that the invasion might be localized by natural conditions unfriendly to the invader.

These hopes were disappointed. In 1930 and 1931 there occurred an outbreak of malaria in the vicinity of Natal whose severity was unprecedented in the annals of the city. The Yellow Fever Service was compelled to undertake control of this mosquito in order to maintain an efficient staff for its own work.

By 1931, gambiae mosquitoes, following prevailing winds, had traveled up the coast 115 miles. Two years of severe dry seasons seemed to check the invasion, and then, with the return of normal rainfall, the onward flight started again. Within a few years, severe epidemics of gambiae-carried malaria had occurred in localities over 200 miles west and north of Natal. In the Jaguaribe Valley alone there were over 50,000 cases of malaria in 1938. Over 90% of the population was affected, with mortality in certain districts estimated at 10%. So disabling and widespread was the epidemic that, in some parts, crops were not planted and salt production was greatly reduced because of lack of labor. It was estimated that as a result of the ravages of this mosquito nearly every person in these affected areas would be on government relief in 1939.

George E. Vincent, formerly President of the Rockefeller Foundation, wrote in his report for 1928, "It has been said that a good malaria fighter must 'learn to think like a mosquito.' He must ask: which of many kinds of anopheline mosquitoes shall I try to imagine myself? How far is it possible to fly? When and where is food to be had? Which blood is to be preferred, human or animal? How can one get into a screened house? Where shall one rest after a good meal? Where is the best place to deposit eggs? Is the water of the right kind and temperature? Is it stagnant or flowing?"

Fortunately, through the work of the Foundation's staff and others in Africa, much is known about the gambiae. It breeds prolifically and rapidly, requiring only seven or eight days to develop from egg to adult, a fact that makes breeding possible in very temporary water collections. It has variable breeding habits, but seems to prefer stagnant, sunlit water. Like other malaria-carrying mosquitoes, it of course has to sting a person infected with the disease to be dangerous. But it has a high infection rate. During the outbreak in the city of Natal in 1930, almost two-thirds of the gambiae caught and examined were found to be infected with malaria, a rate higher than anything hitherto known in the Americas. This mosquito seems to prefer human to animal blood, and it usually bites indoors, not outdoors. Fairly reliable records indicate that the insect can fly a distance of more than three miles.

Late in 1938 representatives of the Brazilian health service and the Rockefeller Foundation staff investigated the infected area in North Brazil. What they found confirmed the seriousness of the situation. Once the gambiae gets into a river valley it spreads up the valley unless blocked at some point by natural or artificial barriers.

With the assistance of the Rockefeller Foundation an anti-gambiae service was organized. As there was not sufficient time to develop a separate agency, this was organized as a part of the existing local yellow fever service. This affiliation made available the wide experience of a well trained group of men accustomed to working under discipline. Except for the distribution of quinine by field personnel working in infested districts, this service did not include responsibility for medical care of the sick in dispensaries or otherwise. The intended purpose of the service was to confine the gambiae to the relatively arid areas it occupied, and possibly even to exterminate it there. If, on the other hand, the mosquito should break through to the well-watered Parnahyba and São Francisco River Valleys, it was realized that further efforts might fail to prevent its spread to a large part of South, Central, and perhaps even North America. The insect was already nearly half way to the Parnahyba Valley.

An appropriation of $100,000 was set aside by the Rockefeller Foundation for expenditure on the problem in 1939. The Government of Brazil also earmarked substantial sums.

The dreaded gambiae had now spread over 300 miles to the west and infested an area of 12,000 square miles. It had often traveled by boat from point to point along the shore. The interior of the State of Rio Grande do Norte in this section is extremely arid at all times, and the mosquito failed to penetrate far inland, but it succeeded in breeding its way along the flat alluvial shelf. This strip is so narrow in several places that the work of 15 or 20 men would have been enough to halt the invasion at any time during the early years.

That gambiae did not spread southward from Natal during all this time is a piece of good fortune not easy to explain. True, the prevailing winds are in the opposite direction, but the mosquito might have made progress against the wind in cars, boats, and trains. Until recently no attempt was made to fumigate them.

Aroused by the calamitous epidemics that occurred in 1938, the national government of Brazil in 1939 increased its appropriation from a quarter to a half a million dollars. Plans for 1940 provided for a further increase, and in that year the Rockefeller Foundation set aside $230,000. The additional economic loss caused directly or indirectly by the offspring of the original gambiae, as well as the human suffering, are difficult to estimate.

The first results in 1939 were frankly disappointing. The counterattack coincided with the beginning of the rainy season, during which the gambiae advances by leaps and bounds, and this, together with a shortage in trained personnel, prevented any early results. As anticipated, widespread epidemics of malaria occurred, and during the first few months of the Service some 114,000 persons were treated for the disease. During these early months the only visible consequence was a lowering of mortality from malaria through medication of acute cases.

By the beginning of July, however, a staff of over 2000 doctors, technicians, scouts, inspectors, guards, and trained laborers was available, and even though the rainy season was unusually prolonged appreciable results were obtained. Further spread of gambiae in the frontier districts was minimized, and the incidence of the mosquito was reduced in certain heavily infested sections to a point where careful surveys repeatedly failed to reveal the presence of either larvae or adults.

The campaign was revealing that both climate and physical geography were indispensable allies. Gambiae is a mosquito which breeds mainly in residual rain-water pools, shallow, open to the sun and without vegetation. It does not lay its eggs in permanent or deep water, in running, salty or shaded water or in water supporting aquatic vegetation. On the other hand, it takes advantage of every little depression in the ground, such as wheel tracks or hoofprints, no matter how shallow or small, which can present a water surface for eight or nine days. During the rainy season, with its almost daily showers, gambiae becomes a formidable antagonist. But the rainy season is restricted to four months out of the twelve, from February through May.

For eight months in the year, the heat of the tropical sun, the strong continuous trade winds, and the low humidity combine to dry up all shallow surface waters and to make life precarious and of short duration for the gambiae. Potential breeding places are reduced to disconnected pools in the beds of the large rivers, none of which maintains a flow in summer. Most of the higher rolling country back from the coast is practically non-infectible by gambiae. Its arid, stony soil supports a scrub vegetation composed of a resistant, thorny bush mingled with cactus. The region is without water for larvae, and without shelter for gambiae adults.

The plans of the campaign against gambiae were like the plans of an army on defense. The frontiers of the infested region were defined by fumigation posts on all the outgoing roads. These were the forts of this new kind of Maginot Line. Every automobile and train leaving the infested area had to be stopped, inspected, and fumigated. A maritime service was organized at points along the coast to disinfect every boat or plane bound for clean ports.

A 10-mile zone beyond the gambiae's farthest limit of advance was to be kept non-infectible, which from the mosquito's point of view represents the "scorched earth" policy. Within this zone, as well as within the area already infected, all breeding places of the mosquito had to be eliminated or treated with Paris green or other larvicide. The whole region was mapped from the air so that no pools, ponds, or other collections of water would be overlooked. The adult mosquitoes were sought and killed in houses with insecticide sprays to diminish the chances of their laying eggs and thus perpetuating the havoc. It was a war in a very real and grim sense. Unlike other types of war, its purpose was the preservation of human life.

By December, 1939, the invader had been pushed back to its central strongholds in the main river valleys and on the narrow coastal shelf. If it could be held within those limits during the wet season of 1940, those in charge of the campaign began to hope that it might eventually be eradicated from the entire region. This, of course, would mean extermination of the last surviving pair. And as in all campaigns, accidents might determine the issue. Thus in one case the mosquito was transported many miles into previously uninfected territory in an old automobile which followed an improvised wagon road through the jungle and thus avoided the fumigation post on the main thoroughfare. In another case a wedge was driven into the defense line against the spread of the disease when a small fishing boat carried the mosquito up the coast. If the war was to be won it was realized that victory would come only through continued vigilance. The wet season of 1940 would be the test.

At this critical stage in the campaign a concerted effort was made under the direction of Dr. Fred L. Soper, representative of the Rockefeller Foundation in Brazil, to narrow still further the boundaries of the insect's domain. This intensive attack had dramatic results. During the critical wet season the mosquito was pushed back on all sides, so that by the beginning of the dry season it had been practically restricted to the lower Jaguaribe Valley. This made possible the concentration in this area of a large number of workers for the final onslaught beginning in July.

Toward the end of the year it was possible to report that no larvae or adults had been found in the lower Jaguaribe Valley since the first week in September. A small additional focus lying some 35 or 40 miles beyond the known infested area was discovered in October, but it yielded to attack and was apparently clean by the middle of November. And, marvelous to relate, during the last 47 days of 1940 no evidence of gambiae was found in all Brazil.

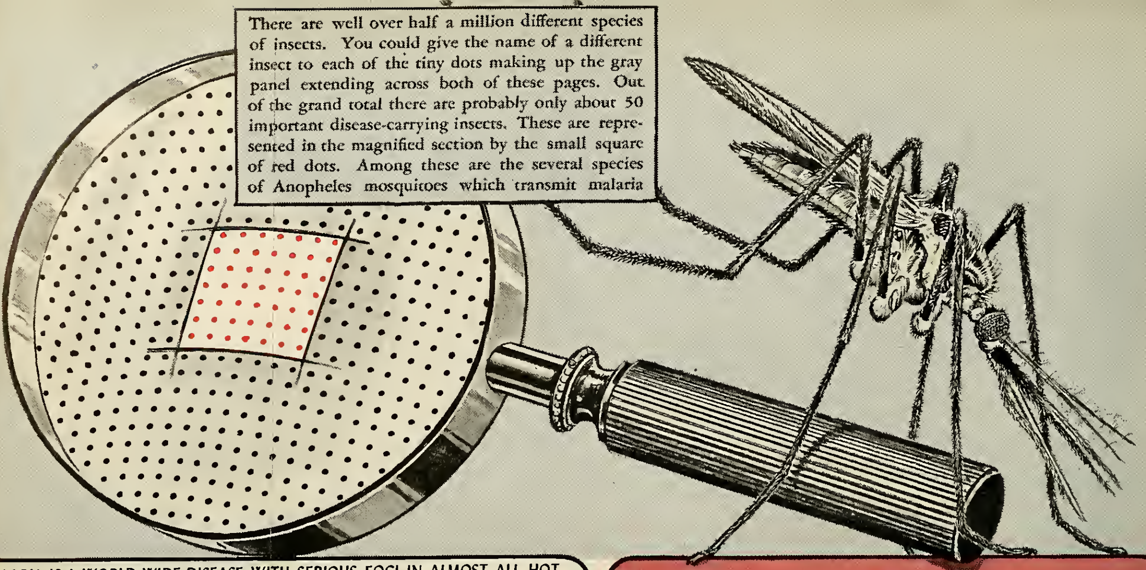
Even in areas of earlier infestation where control measures have been progressively discontinued, the unwanted visitor from Africa has not been seen. In the Icó field laboratory alone, some two million anopheline larvae were examined microscopically during the last eight months of 1940 from areas where control measures had been suspended, and not one of these was a gambiae. Those directing the campaign, therefore, no longer consider it rash to speak of the eradication of gambiae in Brazil. If by chance isolated foci should appear, it could still be said that the critical phase of this campaign is over.

The battle would seem to have been won—but at what labor, cost, and suffering. More than two million dollars was spent on the actual campaign before the gambiae mosquitoes apparently gave up their intention of establishing themselves in the Western Hemisphere.

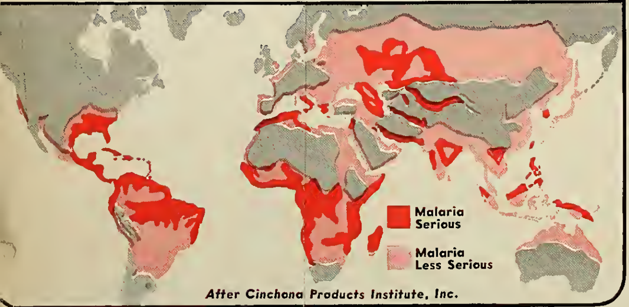
Airplanes are crossing the South Atlantic with increasing frequency, but commercial planes are now carefully fumigated, both after leaving Africa and before discharging their passengers in Brazil. In October, 1941, a "threatened invasion" is known to have been forestalled. A dead female gambiae was discovered after fumigation in a plane arriving in Brazil. Two more were found last January. The original infestation, with all its subsequent miseries, could readily have been started by a single fertilized female. Truly the price of liberty, as far as this malaria-carrying mosquito is concerned, is eternal vigilance.

Through the courtesy of the author this report will appear as one section of a comprehensive booklet entitled *Insects, Ticks, and Human Diseases* soon to be published by Frank E. Lutz and C. H. Curran under the imprint of the American Museum of Natural History.

There are well over half a million different species of insects. You could give the name of a different insect to each of the tiny dots making up the gray panel extending across both of these pages. Out of the grand total there are probably only about 50 important disease-carrying insects. These are represented in the magnified section by the small square of red dots. Among these are the several species of Anopheles mosquitoes which transmit malaria

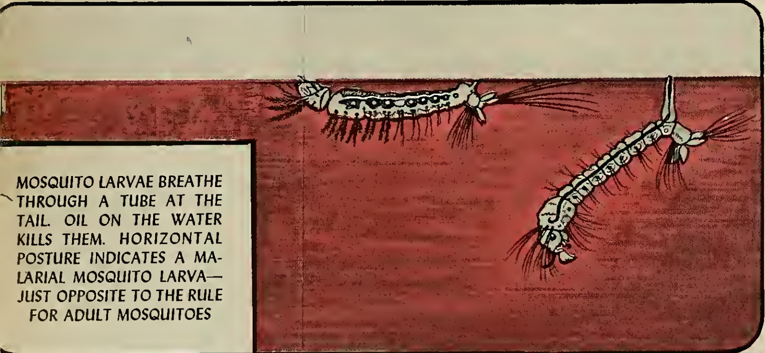


MALARIA IS A WORLD-WIDE DISEASE WITH SERIOUS FOCI IN ALMOST ALL HOT COUNTRIES. IT IS ENDEMIC IN 17 STATES IN THE UNITED STATES

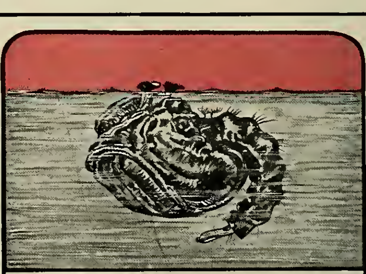


After Cinchona Products Institute, Inc.

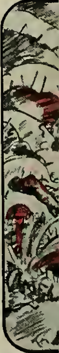
IT WAS ONCE ESTIMATED THAT THE MONEY LOST EACH YEAR THROUGH MALARIA IN THE UNITED STATES WAS TWO AND ONE-HALF TIMES THE ANNUAL OUTPUT OF THE PHILADELPHIA MINT

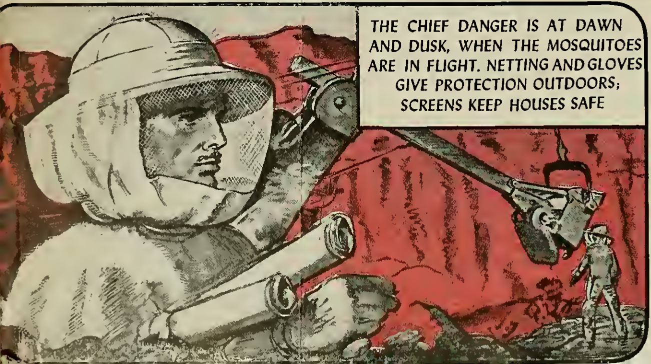


MOSQUITO LARVAE BREATHE THROUGH A TUBE AT THE TAIL. OIL ON THE WATER KILLS THEM. HORIZONTAL POSTURE INDICATES A MALARIAL MOSQUITO LARVA—JUST OPPOSITE TO THE RULE FOR ADULT MOSQUITOES

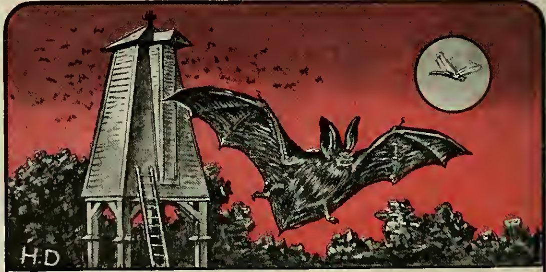


THE PUPA BREATHES THROUGH TWO FUNNEL-SHAPED ORGANS AND CAN ALSO BE KILLED BY OIL





THE CHIEF DANGER IS AT DAWN AND DUSK, WHEN THE MOSQUITOES ARE IN FLIGHT. NETTING AND GLOVES GIVE PROTECTION OUTDOORS; SCREENS KEEP HOUSES SAFE



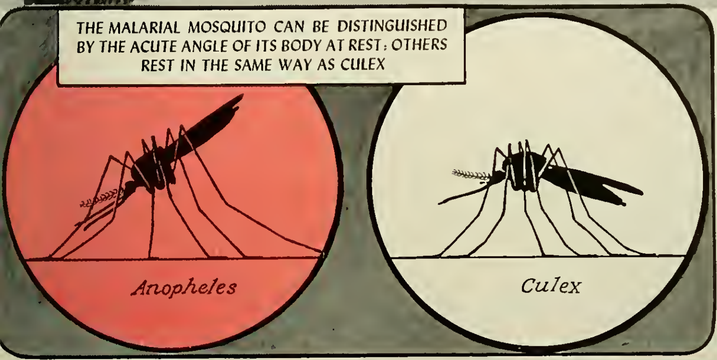
BAT ROOSTS WERE ONCE BUILT TO ATTRACT BATS IN THE HOPE THEY WOULD REDUCE THE POPULATION OF MALARIAL MOSQUITOES, BUT WITHOUT REAL SUCCESS. DRAGONFLIES, HOWEVER, ARE CALLED MOSQUITO HAWKS AND DO CURB MALARIA

Control of MALARIA

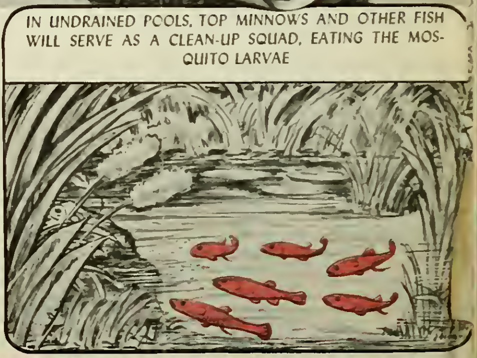
Malaria has a higher sickness and death rate than any other disease. Over 800 million persons suffer with it, and more than 3½ million die of it annually. But control of the disease through scientific methods of prevention and cure is possible and has been accomplished in many parts of the world

Drawn by HARRY R. DAUGHERTY

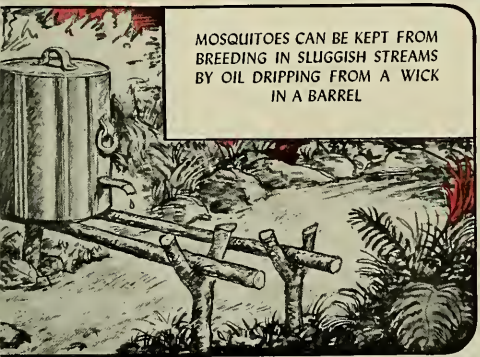
from exhibits in the American Museum of Natural History



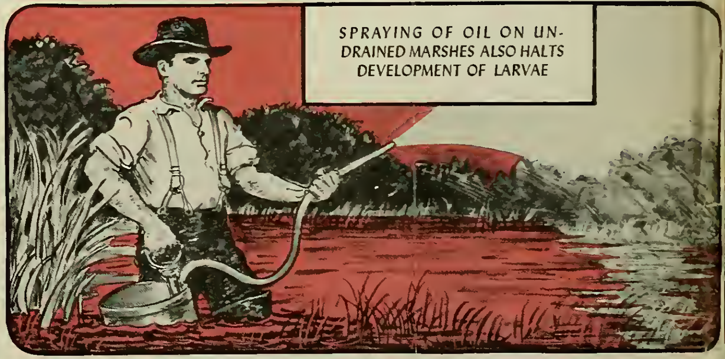
THE MALARIAL MOSQUITO CAN BE DISTINGUISHED BY THE ACUTE ANGLE OF ITS BODY AT REST: OTHERS REST IN THE SAME WAY AS CULEX



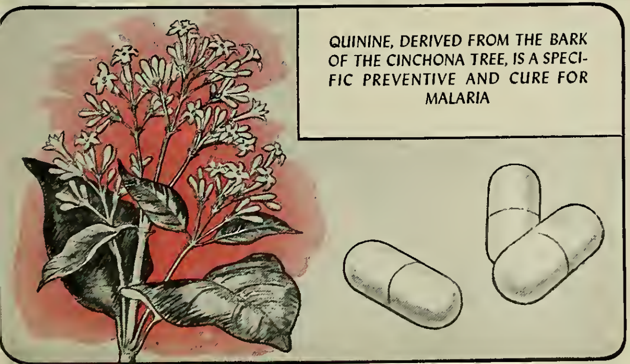
IN UNDRAINED POOLS, TOP MINNOWS AND OTHER FISH WILL SERVE AS A CLEAN-UP SQUAD, EATING THE MOSQUITO LARVAE



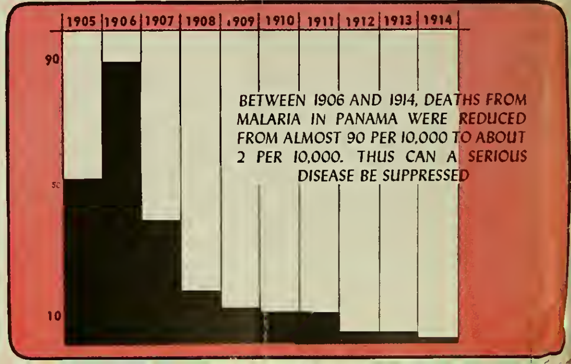
MOSQUITOES CAN BE KEPT FROM BREEDING IN SLUGGISH STREAMS BY OIL DRIPPING FROM A WICK IN A BARREL



SPRAYING OF OIL ON UNDRAINED MARSHES ALSO HALTS DEVELOPMENT OF LARVAE



QUININE, DERIVED FROM THE BARK OF THE CINCHONA TREE, IS A SPECIFIC PREVENTIVE AND CURE FOR MALARIA



BETWEEN 1906 AND 1914, DEATHS FROM MALARIA IN PANAMA WERE REDUCED FROM ALMOST 90 PER 10,000 TO ABOUT 2 PER 10,000. THUS CAN A SERIOUS DISEASE BE SUPPRESSED

QUININE

By ANNA KOFFLER

We have become so familiar with quinine that we almost take it for granted. We never would dare to go to a tropical country, or a subtropical one where malaria is spread, without a supply of quinine, and every soldier sent to the tropics should carry quinine tablets with him. But around 90 per cent of the world supply of quinine is produced in the Netherlands East Indies, and the thrust of Japan into the enormous riches of those islands means also a drive to the world-center of the cinchona (pronounced sin-kon'a) trees, from whose bark the alkaloid quinine is obtained.

The cinchona trees themselves, however, are not native to Java, where now the big cinchona plantations are to be found. On the contrary, they are truly American trees, indigenous to South America. They are native to the mountain forests of Bolivia, Peru, and Ecuador, where they flourish chiefly at altitudes between 5,000 and 8,000 feet. About 40 species of cinchona have been identified, but only about a dozen of them are economically important, and only four are used medicinally. The so-called *Cinchona officinalis* yields the crown bark of commerce; *Cinchona calisaya* and *Cinchona succirubra* provide the yellow and the red bark respectively; and *Cinchona ledgeriana* is by far the finest tree, with a high yield of quinine.

Some believe that the Indians had probably discovered the marvelous properties of this drug before the Europeans came; others do not. In 1630 Francisco Lopez of Canizares, Corregidor of Loxa in southern Perù, is said to have been stricken with malaria and to have been cured by an old Indian medicine man who administered cinchona bark. The first unmistakable reference to cinchona, however, was in 1633. And it is now definitely known that a knowledge of quinine had reached Europe by 1643, for in that year we find mention of it in Belgian literature. Nobody knows how cinchona bark got to Europe; and concerning both its name and its voyage across the Atlantic, the record has become confused. The Countess of Chinchon, wife of a Spanish viceroy of Peru, figures in an explanation commonly given. She is said to have become ill with intermittent fever and to have been cured with cinchona bark, whereupon she took a quantity of it with her back to Spain. But the woman for whom cinchona bark is supposed to have been named never even went to South America. And the second wife of the Count of Chinchon, who might be an alternative possibility, is shown on excellent evidence to have scarcely been sick a day in her life and to have died in Cartagena without returning to Europe.*

What we do know is that the Jesuits, influential in the 17th century Spanish Court, became interested in the bark and later acquired a monopoly for its distribution. They popularized it to such an extent that it became known as *pulvis Jesuiticus*—the Jesuit's powder, under which name cinchona bark is known even today. The name quinine itself goes back to the Incas, who called it in their language *quinquina,* which simply means bark. In the seventeenth century prices which make us shudder were paid for quinine. For instance, the English physician Sir Robert Talbor, or Tabor, was paid 2000 louis d'or and was made a nobleman by Louis XIV for curing the Dauphin from intermittent fever and providing a small supply of cinchona bark. The present price of quinine is 69¢ an ounce.

But though the bark itself had become so popular, the plant which yielded it remained botanically unidentified until 1753, when the French Government sent a scientific expedition to South America. Two of its members, Joseph de Jussieu and La Condamine, discovered the trees and managed to collect many young plants. But neither of them could preserve what they had collected under indescribable hardships and toils. Jussieu remained fifteen years in South America and was able to make a fine collection of cinchona seed and young plants, but on the evening before his departure he was robbed of all the fruits of his labor. Because of this event, which had deprived him of his life's work, he became insane. La Condamine's collection, on the other hand, was lost during transportation down the Amazon River. He managed, nevertheless, to send a sample to the famous Swedish botanist, Linnaeus, who named the genus in honor of the Countess of Chinchon.

It took another century for a species of cinchona, the so-called *Cinchona calisaya,* to be raised in a European garden, in the Jardins des Plantes in Paris.

In the course of time the demand for the cinchona bark became so great that there was danger of the future supply being entirely damaged by the reckless stripping of the trees. The South American forests were for a great part simply destroyed, the trees being felled for their bark. Hand in hand with the threatening scarcity went an increase in price. In the beginning of the nineteenth century the incredible sum of 112 English pounds was paid for a kilo of quinine! The high price and the situation in South America stimulated many vain attempts to find a natural or synthetic substitute for quinine. But as no practical results could be obtained and the situation became more urgent from day to day—especially as the scourge of malaria raged over all tropical countries and took millions of victims—the idea arose to create cinchona reservations in other countries, where soil and climatic conditions were suited. Suggestions were made to establish cinchona plantations in certain districts of India and Ceylon and on the isle of Java, districts similar in climate to the primary South American regions. The first experiments failed. It

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*A. W. Haggis, "Fundamental Errors in the Early History of Cinchona," *Bulletin of the History of Medicine,* October and November, 1941, Vol. X.

In old South American emedy steps into the world struggle

took tremendous efforts, unceasing energy, determination, courage, and patience to establish successful plantations.

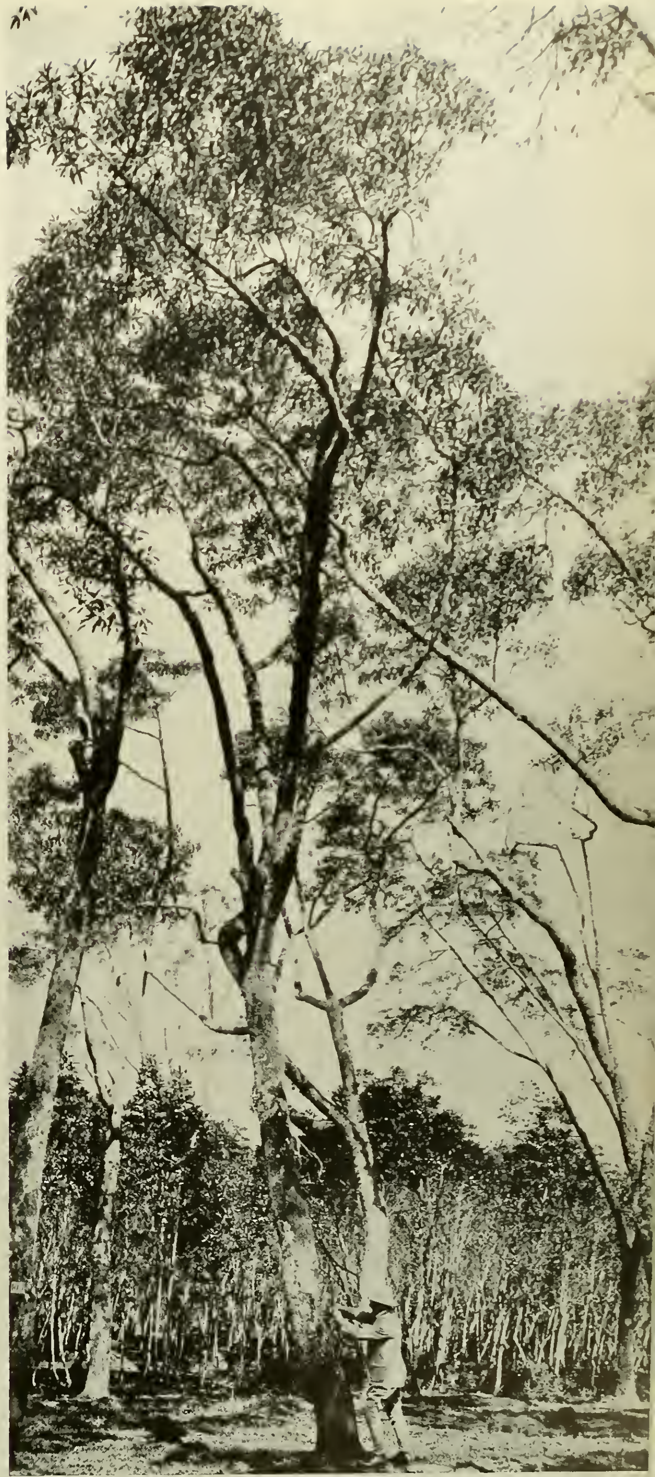
The main concern in the beginning was how and where to obtain the necessary seed and young plants. In 1852 Hasskarl was sent by the Dutch Government to South America, and in 1859 Sir Clements R. Markham was entrusted by the English Government with the difficult task of procuring seeds. In 1853 Hasskarl found the first cinchona tree at Monobamba, Bolivia, and soon afterward sent seed and plants to Europe. Though the seed arrived, the plants withered away during the long journey. Yet Hasskarl did not give up. Encountering innumerable adventures, he succeeded under great hardships and risks in gathering a second collection, which was sent directly to Buitenzorg in Java. When the boxes arrived and were opened, only 75 plants out of the 500 had survived. These were brought to Tjibodas, at an elevation of about 2000 feet, where in the meantime the seed previously collected arrived. The seed was sown and the 75 plants were planted.

These seeds were of the *Cinchona officinalis* and *calisaya,* which yield the crown bark and the yellow

➤ While vital to the health of armed forces throughout most of the tropics, quinine is produced chiefly in regions now occupied by the Japanese. At right: the original trees imported to the Netherlands East Indies from their South American home in 1866

⮟ An ounce of seeds will produce 25,000 plants, but climate and soil must be just right, and the bark does not reach its maximum yield for four years

Netherlands Information Bureau Photos



Deé Bredin Photo from Black Star

▲ Under a free people, this native of the Netherlands East Indies works to live; under totalitarian rule he will live to work. His skillful hands are grafting two species of cinchona in order to produce a sturdier plant and to obtain a higher quinine yield

◀ High grade grafting after five months results in the production of superior plants like these, at one of the Netherlands East Indies experimental stations

Netherlands Information Bureau Photos

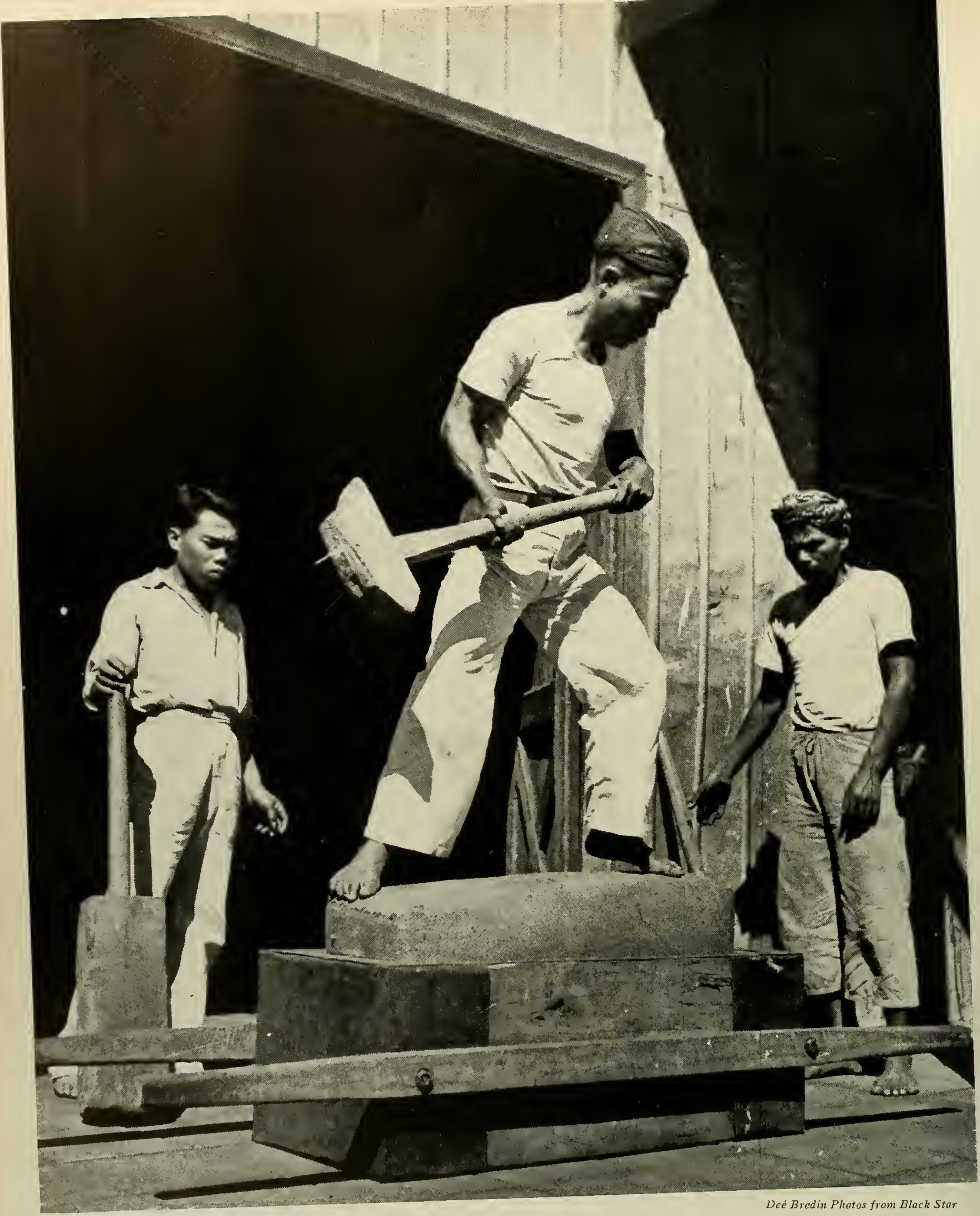
▼ Two-year-olds wearing the delicate pink, white, and yellow blossoms of the lovely flowering cinchonas

When six years old, the plantation is thinned out. Below, natives are stripping bark from uprooted trees

▲ IN THE REGION that produces 95% of the world's quinine, men chop the trees down and women debark them. The Dutch stopped shipping quinine to Axis powers with the invasion of Holland, but now Japan controls the source

▼ AFTER malleting the bark, strips are placed in the sun to dry and are then taken to enormous indoor ovens to complete the drying

Deé Bredin Photos from Black Star



Deé Bredin Photos from Black Star

⮝ Sledge hammer, and footwork mold the powdered cinchona bark into tight 100-kilo bags for shipment from plantation to factory. There it is mixed with water and oil and subjected to a distillation process which leaves the crude quinine as a sediment

➤ Second in importance to ammunition is quinine to the Allied soldiers in tropical regions heavily infested with malaria. From stocks on hand or from plantations developed in war-free lands must come the portion that will rest in the pack of every tropical soldier bark of commerce. But it was a merchant by the name of Ledger who, in 1865, advised by his native servant, Manuel Incra Mamani, discovered also in Bolivia the seeds of the finest cinchona tree, which has been called in his honor, *Cinchona ledgeriana.* Today *Cinchona ledgeriana* is mostly grafted upon the hardier *Cinchona succirubra,* from which comes the red bark of commerce. But fate has dealt unhappily with many men throughout the history of quinine. Ledger's faithful servant, who had led Ledger to the finest seeds, was arrested during a second expedition by the Corregidor of Coroico in Bolivia. He died in misery in jail, and the world, and even those who usually cherish the names of men, have forgotten him. It would seem more just if one species of cinchona bore the name of Mamani.

Once the seeds were obtained, there were many problems to be worked out as to the right methods of growing the trees and of collecting the bark. In the course of time it has been found that although the medicinal species thrive where cool nights prevail, they will not stand frost. After unceasing work, the Dutch succeeded in raising the greatest cinchona plantations of the world.

The blossoms of the cinchonas are of very delicate pinkish, white, and yellow shades; they grow in rich tufts, and from them come the seeds in equal abundance. The seeds are methodically collected in white linen bags—easily one pound of seeds can be collected during one morning by shaking the fruiting branches—and are sorted by native girls on glass plates which are electrically illuminated from below. Although the seeds keep their germinative power for several months, they are not collected long before it is planned to sow them. One ounce of seed will produce some 25,000 plants. The seeding usually takes place after the spring monsoons, the seeds being strewn by hand in open beds on specially prepared soil. After six weeks they germinate, and after about six months, when they are one foot high, *Cinchona ledgeriana* is grafted upon *Cinchona succirubra.* Two or three months later they are transplanted to the nurseries, and later on to their final positions.

Many attempts have been made to increase the alkaloidal content of the bark. It has been found that the bark is richest in alkaloids when the tree is about four years old, and that the bark of the roots is even richer in alkaloids than that of the stem.

The most primitive form of collecting the bark is the so-called "uprooting," which was formerly the general practice and which has nearly destroyed the South American reserves. When about ten to twelve years old and still highly productive, the tree is felled, and the bark is stripped from its stems, branches, and roots.

"Coppicing," or as the Dutch call it *op stomp kapping,* is another method which has been tried. In this, the trunk is cut a few inches from the ground. Shoots then spring up from the stumps, of which two are left to form the second "coppice" in the course of time.

A third method, which is called "scraping" or "shaving," is based upon the discovery that the second growth of the bark is, on the average, 20 to 30 per cent richer in alkaloids than the first. Thus the bark is simply scraped off with special bamboo or horn knives as near to the cambium or life-giving layer as possible without injuring it.

It had long been observed that the side of the tree that was away from the sun was richer in alkaloids, hence the process known as "mossing." It was McIvor in the Nilgeri Hills in India who first experimented with this method. He covered the stems of the cinchonas with a thick layer of moss, and the results thus obtained surpassed all expectations. The yield of the alkaloids was often three or more times as much.

From these experiments a new method was developed. Long strips of the bark were removed lengthwise and the exposed space covered with moss. When the bark renewed itself, other strips were removed, and so on, until the whole of the bark was renewed. This renewed bark is rich in alkaloids, and in the course of time is ready for removal. This process can be continued over and over during the normal life of the tree, but it requires skilled laborers, and the basic method of uprooting the tree remains the usual one throughout the East Indian plantations.

The bark contains about 70 per cent water and has to be dried before it is suitable for use. It is either sun-dried or brought to specially prepared drying sheds, where it goes through an oven-drying process. Then the bark, which is very bitter, is shipped in bales of 200 pounds to the quinine factories. Much of the bark often comes to the factory as reddish-brown dust, resembling cinnamon. When all the bark has been pulverized, the distillation process begins. The powder is mixed with water and boiled in great vats to which a kind of kerosene is added. The quinine is taken up by the oil, which is then led to other vats where sulphuric acid is added. The acid removes the oil and leaves the crude quinine as a sediment.

One factory was established in Java at Bandoeng, recently so prominent in the news. Long before Pearl Harbor, indeed since right after the invasion of the Netherlands, the Dutch refused to send cinchona bark to the Axis powers; therefore the goods were delivered only to English, American, or Dutch factories.

About 30 distinct alkaloids have been obtained from the bark, of which quinine is by far the most important. Besides quinine only three others form salts that are officially recognized; quinidine, cinchonine, and cinchonidine. It was the great achievement of several medical authorities, and especially Professor Binz in Bonn, to show that quinine is poisonous to certain protozoa, including malaria parasites. The disease of malaria is caused by the presence of minute protozoa which are injected into man by the sting of the anopheles mosquitoes. They pass their asexual stage of life in the blood of man. There they produce fresh broods with some male and female forms, and each output of a new brood into the blood is accompanied by the symptoms of the malarial attack. Thus man becomes the intermediate host of the malaria parasite, which is again acquired by the female mosquito when the insect bites a person afflicted with malaria. The sexual cycle takes place in the female anopheles mosquito.

Many experiments have shown that quinine is able to kill or inhibit the parasites. Each dose of quinine, taken at the right time, decreases them until they are often totally annihilated. Extensive information as to the doses required was obtained during the last World War. But although wonderful results in the cure of malaria have been obtained with the help of quinine, it is not yet known exactly why and how quinine works in the human organism. The price for quinine went up to $1.50 an ounce during the last World War.

Malaria has unfortunately a very wide range. It occurs in all tropical countries and extensively in subtropical ones. Particularly after rainy seasons, when there have been plenty of breeding opportunities for the mosquitoes, is the problem serious. Malaria is endemic in 17 states in the United States.

What can be done to suppress this scourge of mankind has been demonstrated by the U. S. Government in the Panama Canal Zone, where malaria has been almost completely exterminated in areas formerly seriously infested with it. The breeding places of the anopheles mosquito are destroyed by covering the surface of the pools with oil and strictly insisting that every water container, be it a discarded can or a flower pot in the garden, be emptied of water. Outside of the Canal Zone malaria is a very serious problem in Panama.

Many more persons fall victim to malaria than we usually imagine. The quinine research office in Amsterdam reported that in the year 1923 there were 1,300,000 deaths from endemic malaria in India alone. And a report of the Friends' Russian Famine Relief from the same year states that 60 to 70 per cent of the whole population in South-East Russia were stricken with malaria. The Committee of Hygiene of the League of Nations sent a special Malaria Commission in 1924 to study the organization and cost of a campaign against malaria in Yugoslavia, Bulgaria, Russia, and Italy. All these countries at that time suffered from malaria.

In the meantime much has been done to combat the disease, but much remains to be done. In the years past the price of quinine often remained too high to make its distribution possible on such a scale that would reach all in need of it. When this war is over everything should be done to avoid a return to this condition.

Botanically the genus *Cinchona* belongs to the family of the Rubiaceae, the madder family. The pulverized roots of the madder were generally used as a dye to achieve brown and purple colors, before the invention of synthetic dyes.

As there are families from which come many distinguished men, thus there are plant families whose members are remarkable. To the madder family belong not only cinchona and madder, but also coffee, ipecac, and the gardenia plant. It is surprising to many that this versatile family should produce on the one hand tropical giant trees reaching a height of over 80 feet, and on the other tender herbs only one to two inches high.

Few plants have played such an important role in the history of mankind as cinchona. This remarkable bark has become a key to world-power, has helped to preserve the white civilization in the tropics, has saved innumerable lives and become the economic basis for the existence of thousands and thousands.

More and more details about the action of quinine come to light. Quinidine, one of the other alkaloids derived from the cinchona bark, is used in forms of hyperactivity of the heart. As early as 1872 the renowned Viennese clinician, Oppolzer, said in his lectures on the treatment of internal disease: "The best and most powerful factors in dealing with heart patients are three: rest, digitalis, and quinine."

Not only in medicine, but also in cosmetics and industry, quinine plays a part.

It is of interest that among the many plants used against intermittent fever, the bark of the dogwood has figured rather prominently, often directly as a substitute for quinine. The bark of this familiar small tree of eastern and central America produces a decoction that was known to all the Eastern Indian tribes; and the early settlers, who often suffered from malaria, readily availed themselves of this native remedy. The bark of dogwood became very popular during the Civil War, when South American drugs could not be obtained. But its effect cannot be compared with that of the cinchona bark, since it is only a slightly astringent tonic.

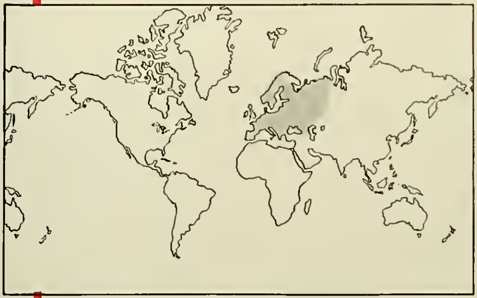
The world demand for quinine reached millions of kilos before the outbreak of this war. The United States imported 4,038,541 pounds of cinchona in the first 9 months of 1931. In time the benefit this remarkable product of nature bestows on mankind may be achieved by synthetic drugs. Atabrine has already been found of great value in the treatment of malaria. But the use of quinine is traditional throughout the areas of the world where malaria is a threat, and the ease of administering it on a large scale makes it especially adaptable for use among our expeditionary forces. Thus the supplies of quinine which the country has stored up will play an important part in the fight for freedom.

World Migrations

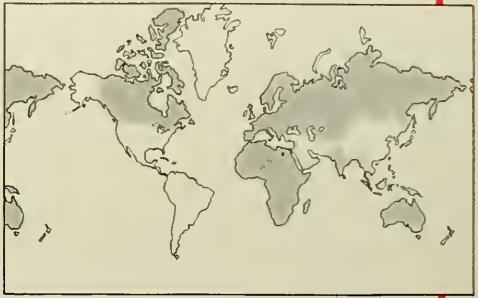
By H. L. SHAPIRO

Chairman, Anthropology, The American Museum of Natural History

In four and a half centuries, the extent of European empire has spread from a mere 7% of the inhabited land area of the globe to approximately 63%. In addition, most of North and South America were under European control for a time but later achieved independence. Thus at one time or another 85% of the world has been under European rule. With the status of many countries, like India, hanging in the balance, the question arises: Is the world moving toward unification or autonomy?



1492



1940

As far back as we can go in time, migrations have played a significant part in human affairs. That this should be so is, when we come to think about it, inevitable. For not only does man, like all other ambulatory creatures, escape from intolerable conditions by flight but he has by virtue of his more complex social and psychological organization a greater capacity for discontent, fancied or real, than any other animal. Thus mankind, living until recently in a world but sparsely occupied by his fellows, has ever been ready and able to push into new areas in the hope of bettering his condition or because he has had no choice but to move.

Of all the mass movements that have taken place in the past, none approach in magnitude of numbers or in area involved the post-Columbian migrations from Europe. The Mongol streams of the thirteenth century, although comparable in the distances traversed, were confined to a relatively small number of conquerors. Similarly, the historically significant Völkerwanderung of the early Christian era shrinks to the level of a local upheaval when compared to the vast eruption of peoples that occurred throughout the world between 1492 and the present day.

Not only were the post-Columbian readjustments of population on a scale hitherto unknown, but the character of the movement and its origins were much more complex and varied than those of previous migrations. It is impossible in a limited space to do justice to the history of this migration, but some idea of its magnitude and ramification emerges when we recall that the period began in the Renaissance and reached its apogee in the modern industrial age. During much of this time revolutions in political, religious, social, and economic affairs in Europe were creating stresses and providing motivations for wholesale migrations. Moreover, the complexity of the phenomenon was greatly increased by the untold number of African natives added to this stream of humanity against their will, and by the numerous Chinese, Hindus, Japanese, and other Asiatics also drawn into these currents of population adjustment that followed on the increasing integration of the world.

So varied a movement cannot be broken up into mutually exclusive categories or phases, but it is possible to discern in this vast population adjustment two contrasting, although frequently overlapping, forces. The first and older was the conquering and exploiting aspect of European expansion. It involved, at most, relatively few men and it began from southwestern Europe. The second factor was largely a colonizing and settling activity which began later and finally affected an enormous number of people from all parts of the world, but especially Europe. The first of these aspects created the great empires and extended the political and economic control of Europe. It engulfed practically all of Africa, it managed to exert control over a large part of Asia and for a time at least held sovereignty over all the Americas. The colonizing impulse was more restricted, finding its major resolution in the New World and in the sparsely inhabited areas of the Old World that were suitable for settlement.

New worlds

The accompanying maps were designed to illustrate this movement of world population in the 450 years since the discovery of America. This beginning date was selected because it symbolizes the sudden expansion of the geographic horizon that occurred in Europe at about that time. Although 1492 conventionally recalls the discovery of the New World, it also represents an era rich in the discovery of hitherto unknown parts of the Old World. As our school histories remind us, Columbus stumbled on the Western Hemisphere while seeking to find the eastern regions of the Old World, and for some time it was thought that the American "Indies" were in fact the East Indies. Contemporary with the exploration of American shores, European navigators were rounding Africa, sailing into the Indian Ocean, opening up trade with the East Indies and China, and traversing the wide reaches of the Pacific. These Old World discoveries were as exciting as the first glimpses of the New World. Indeed to the European of that day a distinction between the discoveries in the New World and the Old was scarcely drawn. They were all part of a new world. Only later when cartographers got busy and drew for all to see did the reality of a new hemisphere become common knowledge.

The fascinating new regions disclosed by this era of discovery, especially the evidences of their wealth, stimulated the European imagination to see in them an extraordinary opportunity for enrichment which they were not slow in pressing. Thus almost immediately after the knowledge of the West Indies reached Spain, steps were taken by the Spanish Government to clinch their claim, and adventurous youth eager for wealth and renown flocked to the new colonies. It is significant that these new areas of potential wealth were regarded as private preserves to be plundered by the Spaniards only. Quick to claim their own fictitious rights, the *conquistadores* never seemed to recognize that the natives had any. Although the Spanish ravages upon native culture and wealth have been highlighted by the dramatic destruction of the Aztec and Inca empires, we must not forget that the English and French were frequently as callous of any moral claims other than their own.

Following upon the heels of the Spaniards, all the remaining powers on the western fringe of Europe, the "Atlantic Nations" of Portugal, France, Holland, and England, rushed in to stake out their claims. They, too, were actuated by imperial and commercial ambition and were eager to exploit the new country. In each case some colonization accompanied the politial and commercial expansion. Only among the English did colonization almost from the outset assume an importance equal to purely economic considerations.

Asia and Africa

But if the New World captured the imperial energy of western Europe first, it was not to remain the only theater of that activity. The same nations spread their hegemony over the newly discovered regions of the Old World as well. Spain gained control of the Philippines; Portugal acquired scattered footholds in China, India, and the islands to the south; the Dutch won the East Indies; while England and France fought for India. But colonization in these already densely settled and flourishing areas never amounted to much. The European expansion here was simply one of exploitation and has remained political and economic to the present day. Africa, which was partitioned later, fell largely to the same powers,—with the addition of Italy, Germany, and Belgium as imperial factors consistent with their increased importance in this later epoch. As in the case of southern and eastern Asia, the European control of Africa was merely for economic and political advantages except for South Africa, which proved to be suitable for European settlements on a large scale.

The islands of the Pacific and Australasia also came under the same imperial influences, with Australia, New Zealand, and Hawaii alone becoming significant areas of colonization and settlement.

Only in the northern tier of Asia were the imperial powers of western Europe shut out. The vast expanse from the Urals to the Pacific, inaccessible from the south and blocked by China on the east, remained an easy conquest for Russia, which possessed a natural entry into the region. The sparse and loosely organized settlements of Siberia not only yielded readily to Russian control but also provided little opposition to a vast Russian colonization—a resettlement that has recently been taking place hardly known to the outside world.

Thus, although the European *imperium* has spread over the major portion of the world during the 450 years since Columbus, the actual movement of European populations within this period has been limited to only a fraction of the area at any one time within the control of European powers. The accompanying maps show that the principal fields of European colonization have been North and South America, Asiatic Russia, Australasia, and South Africa. Of these, North America has received the greatest number of settlers.

Latin America

The first colonizers to leave Europe came from Spain, often as adventurers who remained to settle in the New World as landowning overlords. Having established their primary base in the West Indies they soon invaded the mainland, until their hegemony stretched from California and the southern United States to the tip of South America. All this vast region, except for the Portuguese in Brazil, was Spanish. It has been estimated by Rosseeuw St. Hilaire that about three million Spaniards all told emigrated to Latin America during the first 150 years after the discovery. Kuczynski, a leading authority on population, feels however that this is an excessive figure, since not enough shipping was known to have been available during this period to transport such a number.

The settlement of the northern parts of the New World began slowly in the latter part of the sixteenth century, gathering momentum in the following century as the Atlantic coast settlements came into being. The colonists were largely English, with some representation from various other northwest European countries. It is doubtful if the volume of colonists who settled in North America had by the time of the Revolution yet overtaken the Spanish migration in numbers.

During the sixteenth and seventeenth centuries the tide of European migration set firmly toward the New World. In the eighteenth century the flow continued to move in the same direction but with minor diversions toward South Africa and Australia. In the nineteenth century the tide became a flood. Not only were the number of migrants increasing amazingly, but new sources of supply were opening up all over Europe. For the first three centuries Spain, the British Isles, Holland, and France were the principal suppliers of colonists. In the nineteenth century Germany, Ireland, and later Italy, Austria-Hungary, Poland, and Russia, not to mention the smaller countries of Europe, poured forth thousands upon thousands of their natives to join the greatest hegira in the history of man.

Most of this movement followed the lines already established. From 1820 to 1935 Kuczynski estimates that 55 millions entered the Western Hemisphere from Europe alone. By far the major portion of this number settled in the United States. Many, of course, returned after a temporary residence, but the net number of permanent settlers in this period was probably well over 35 millions. During the same century about four millions migrated to Australia and over a million to South Africa.

Control of immigration

The restrictive measures adopted by the United States after the first World War to control immigration has had necessarily a considerable effect upon the size and direction of European emigration, since this country was the largest receiver of European settlers. These barriers have tended to divert many colonists to South America, particularly those from Southern Europe.

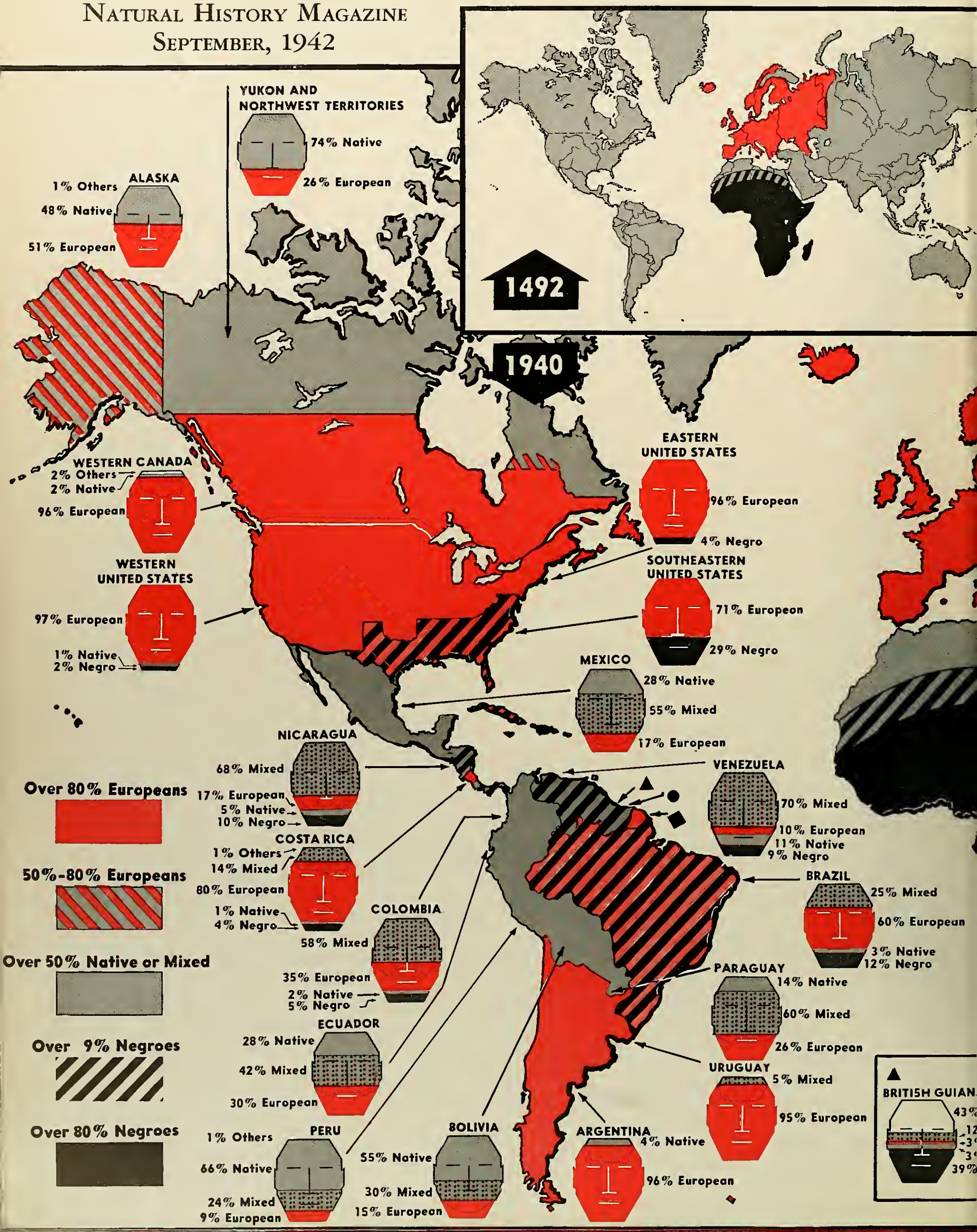
On a scale almost comparable to this movement to the New World has been the Russian expansion into the vast Asiatic hinterland. Millions of peasants have been moved to the forests, mines, and fertile plains of Asiatic Russia in a tempo immeasurably increased since the Russian Revolution. The epic of this tremendous migration and the story of the exploitation of the Russian East is in many respects similar to the opening of our own West.

Negroes in The New World

This spilling over the bounds of Europe did not, however, continue without its profound effect upon

MAJOR MOVEMENTS OF

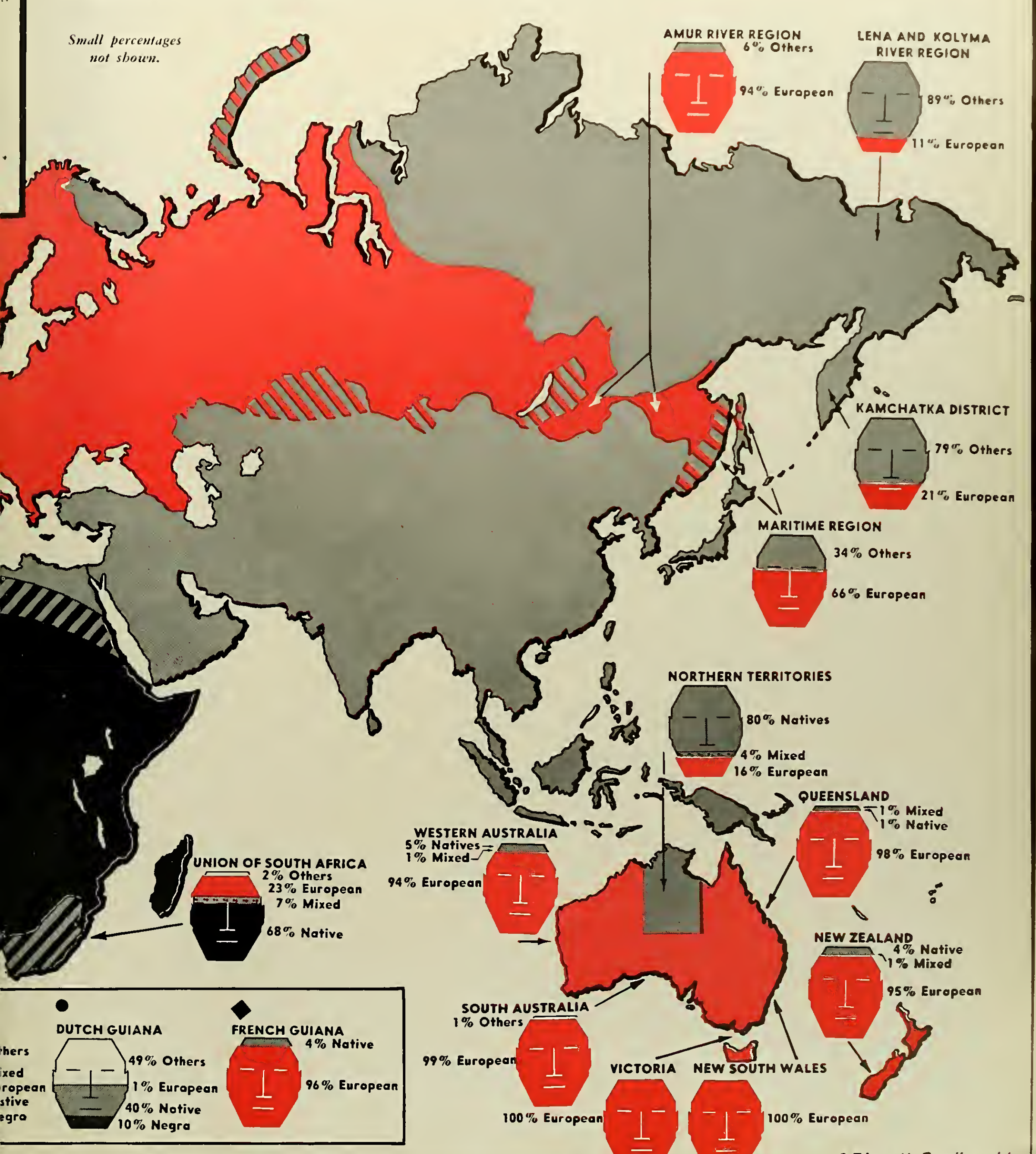
Natural History Magazine
September, 1942


1492
1940
YUKON AND NORTHWEST TERRITORIES
74% Native
26% European
ALASKA
1% Others
48% Native
51% European
WESTERN CANADA
2% Others
2% Native
96% European
WESTERN UNITED STATES
97% European
1% Native
2% Negro
EASTERN UNITED STATES
96% European
4% Negro
SOUTHEASTERN UNITED STATES
71% European
29% Negro
MEXICO
28% Native
55% Mixed
17% European
NICARAGUA
68% Mixed
17% European
5% Native
10% Negro
COSTA RICA
1% Others
14% Mixed
80% European
1% Native
4% Negro
VENEZUELA
70% Mixed
10% European
11% Native
9% Negro
COLOMBIA
58% Mixed
35% European
2% Native
5% Negro
BRAZIL
25% Mixed
60% European
3% Native
12% Negro
ECUADOR
28% Native
42% Mixed
30% European
PARAGUAY
14% Native
60% Mixed
26% European
URUGUAY
5% Mixed
95% European
PERU
1% Others
66% Native
24% Mixed
9% European
BOLIVIA
55% Native
30% Mixed
15% European
ARGENTINA
4% Native
96% European
BRITISH GUIAN
43%
12
3
3
39%
Over 80% Europeans
50%-80% Europeans
Over 50% Native or Mixed
Over 9% Negroes
Over 80% Negroes

EUROPEAN POPULATION

European colonization has moved primarily into the New World, with subsidiary movements to Asiatic Russia, South Africa, and Australia. It has flourished most, however, in the temperate zones. The spread of Negroes has been almost entirely westward, to the warmer areas of the New World, where they have entrenched themselves and set up a secondary center of population. They have expanded relatively little beyond the Caribbean area except along the Brazilian coast and the southern and eastern United States

By Harry L. Shapiro


Small percentages not shown.
AMUR RIVER REGION
6% Others
94% European
LENA AND KOLYMA RIVER REGION
89% Others
11% European
KAMCHATKA DISTRICT
79% Others
21% European
MARITIME REGION
34% Others
66% European
NORTHERN TERRITORIES
80% Natives
4% Mixed
16% European
QUEENSLAND
1% Mixed
1% Native
98% European
WESTERN AUSTRALIA
5% Natives
1% Mixed
94% European
UNION OF SOUTH AFRICA
2% Others
23% European
7% Mixed
68% Native
NEW ZEALAND
4% Native
1% Mixed
95% European
SOUTH AUSTRALIA
1% Others
99% European
VICTORIA
100% European
NEW SOUTH WALES
100% European
●
DUTCH GUIANA
49% Others
1% European
40% Native
10% Negro
◆
FRENCH GUIANA
4% Native
96% European
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egro

D.F. Levett Bradley_del.

movements of people on other continents. It set up movements of native population within the areas of immigration and in some cases resulted in the extermination of the aborigines. But in addition to these local consequences the expansion of Europe also drew into itself a series of subsidiary non-European migrations. One of the most significant of these was the resettlement in the New World of approximately fifteen million Negroes from Africa. The Spaniards, almost immediately after establishing their settlements, began to ship Negroes to their plantations as slaves to replace the unsatisfactory Indians. After 1600 the Dutch and the French also engaged in this traffic, and by 1650 the English were also actively involved. The shipments continued as late as 1830 to Cuba and 1860 to Brazil. The total numbers thus transported can only be estimated. Between 1655 and 1787, 676,276 were known to have been legally imported into Jamaica, and in the year 1771 alone, 47,146 Negroes were carried in British vessels. From these figures it is obvious that the movement was on a large scale. DuBois has calculated the following numbers of Negroes imported into the New World.

	900,000	in	the	16th	century
	2,750,000	"	"	17th	"
	7,000,000	"	"	18th	"
	4,000,000	"	"	19th	"
TOTAL	15,000,000				

This total represents those who actually arrived in America. If the enormous loss of life that took place aboard slavers were added, the total number of Negroes leaving Africa would be much greater.

Historically, the Caribbean area was the center of the slave traffic, and it is here that the Negroes in the New World have most completely replaced other elements. As one moves north or south from the tropical belt the proportion of Negroes decreases. Similarly the concentration of Negroes relative to the population declines from east to west. This is very evident not only in the United States, but especially in South America. It is tempting to attribute this form of distribution in part to ecological factors of climate and environment which might have conditioned the manner of Negro dispersal in the New World, but historic factors must also have been effective.

In this connection it is worthy of comment that the distribution of Europeans in Central and South America also reveals a distinct pattern. The relative frequency of population of such origins is least along the Andean and Cordilleran system, precisely where the native populations were heavily concentrated in highly organized civilizations. It would repay investigation to determine whether or not the well-organized masses of aborigines were able in these regions to hold their own more effectively against European encroachment than in other regions occupied by loosely associated hunting tribes. Moreover, the survival of native population in these regions offers another explanation for the relative absence of Negro settlement.

Immigrants from Asia

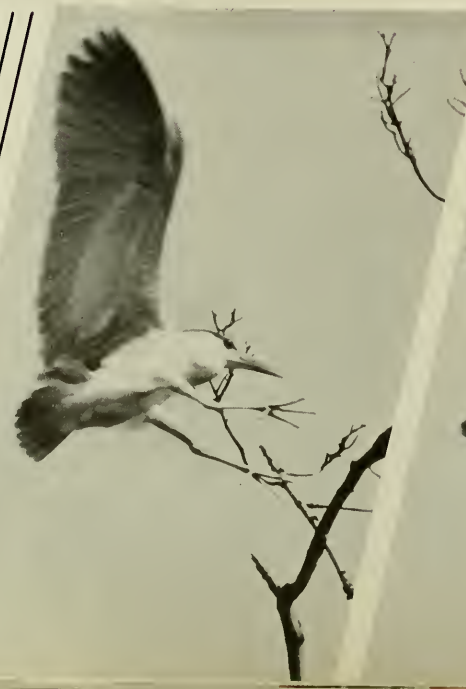
In the Old World, too, migrations of non-European populations have been stimulated by European expansion. Although the Chinese, Arabs, and Hindus had, long before the advent of the white man in their worlds, been known to have been expanding, the rate and extent of their migrations were enormously increased during the nineteenth and twentieth centuries as a result of conditions made possible by European hegemony. The Chinese, for example, increased their flow of emigrants to the East Indies, the Philippines, southeast Asia, Hawaii, the United States and various other parts of the world. The Hindus were moved to Africa, Fiji, and southeast Asia as labor demanded. More recently the Japanese, who previously had been closely confined to their own islands had begun a movement of emigration in various directions. These migrations of Asiatic people, although on a smaller scale and with a different history than the European expansion, nevertheless form part of the same picture of a world in population readjustment.

Although the movements of population in the last few centuries have been vaster and more dramatic than any we have known up to now, it would be a distortion to assume that they represent a process that had previously been negligible. On the contrary, the entire history of man, both from his written records and from his archaeological traces, reveals a constant flux of population. I doubt if one could find anywhere in the world a people whose history and records do not reveal evidence of migration. As for Europe I do not know of a single country that has not been overrun not once but repeatedly in the course of its history. What makes the present cycle of migration distinctive is the rapidity of the phenomenon, its colossal numbers, and its world-wide character.

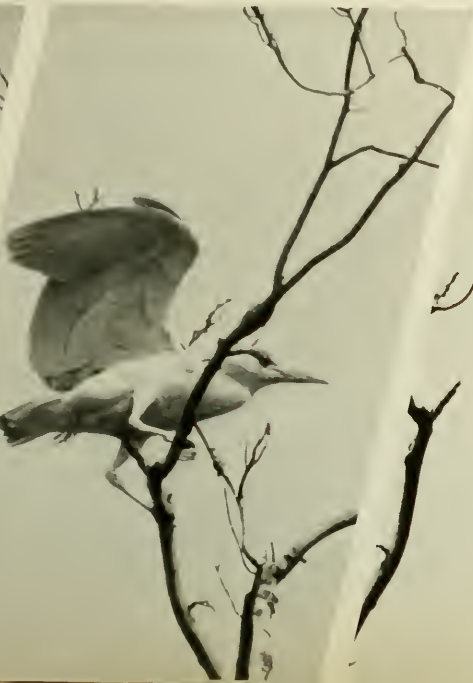
A HERON ALIGHTS AND TAKES OFF

This remarkable series of photographs were taken by the accomplished bird photographer, Dr. Heathcote Kimball. They show the wing- and leg-action of the Black-Crowned Night Heron with a clarity that makes them a contribution to the study of bird flight as well as an example of the artistic achievement that is possible to the naturalist who does his hunting with a camera. The photographs were taken at Kings Point, Long Island, a few miles from metropolitan New York.

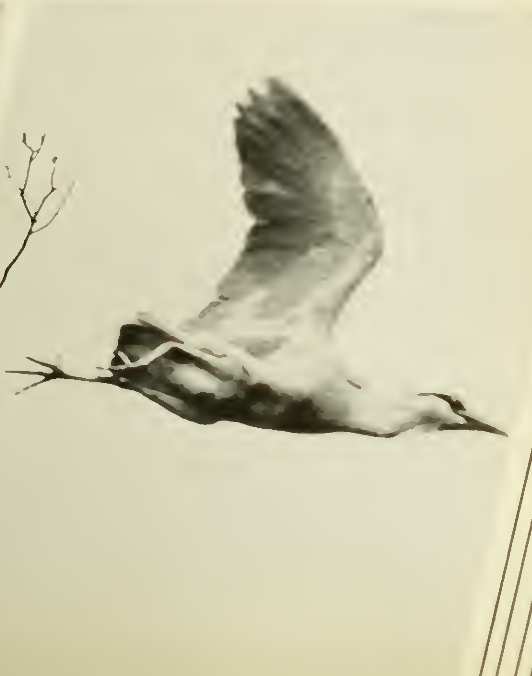
With toes spread to their utmost to grasp the perch, the heron breaks its speed with its wings and comes in for a perfect landing



The feet close on the limb and the body is in perfect balance as the wings fold



A powerful thrust of the legs sends the bird forward, and the wings are prepared for a downward stroke that will carry the heron into full flight



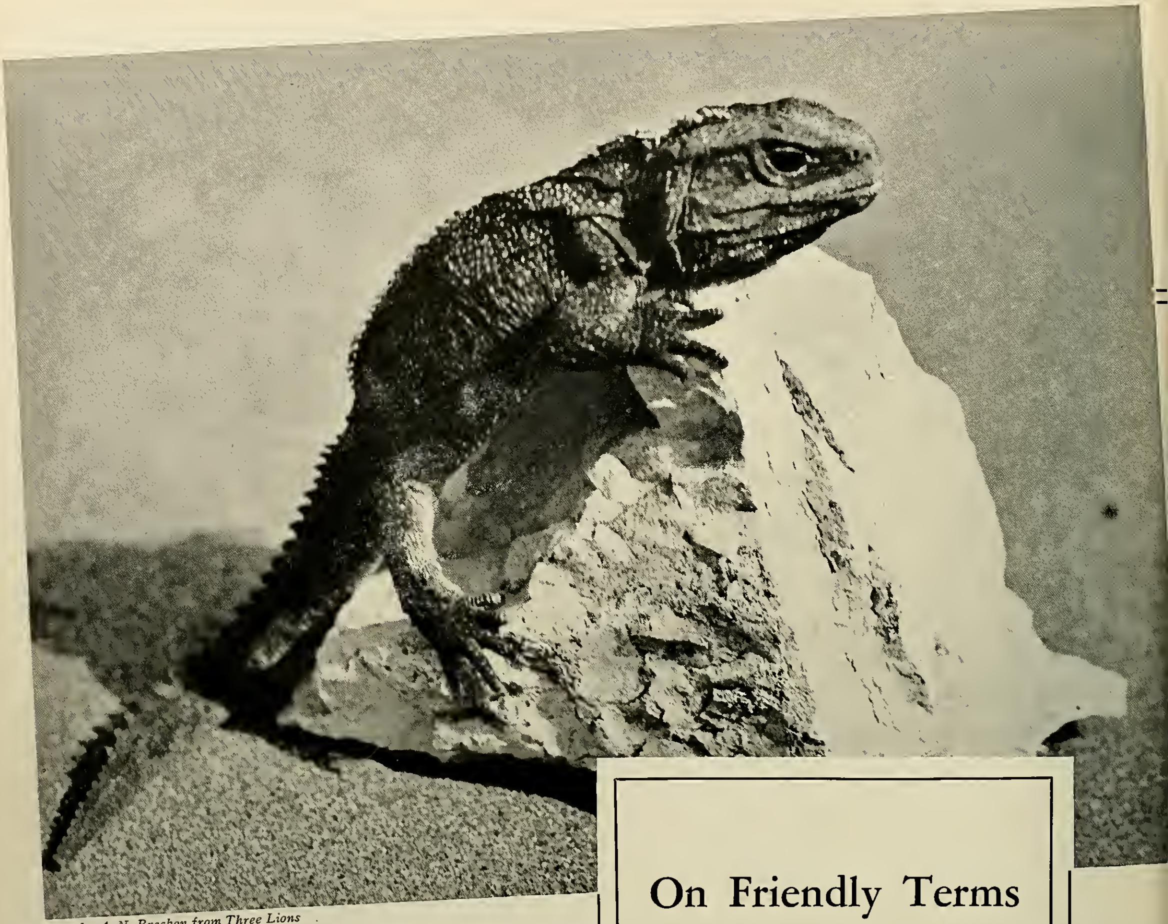


Photo by A. N. Breckon from Three Lions

On Friendly Terms with the TUATARA

By T. E. Donne

Over half a century ago the Government of New Zealand required me to visit Stephen Island off the coast of South Island.

In those far-off days the means of landing persons thereon were primitive, as no jetty existed and the seas were too rough to permit the use of a small boat.

My arrival coincided with a gale, and huge waves were dashing to a height of 30 or more feet against the rock-bound cliffs of this high and steep-sided island.

A rope sling was placed around my body and attached to a block and tackle outfit on the end of a derrick on the government Steam Yacht "Hinemoa." This vessel of narrow build, pitched and rolled in a lively manner; when it rolled to starboard I was hoisted high into the air and when it rolled to port I found myself in the cold embraces of white-crested waves. After seesawing several times, I was landed and unshackled in the twinkling of an eye.

On the top of this island lived the lighthouse-keepers and their families.

In the evening as the sun was setting in a blazing sky, thousans upon thousands of dove petrels came from the north. Many of them passed by Stephen Island, but many hundreds settled thereon for their night's rest after a day's scouting over the ocean in

In which a man explores the personality of the sole survivor of one of the most ancient and primitive orders of reptiles

A RELIC from the Age of Reptiles, the tuatara retains the vestige of a third eye on the top of its head, with tiny lens and retina

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search of food. They covered the top of the island like a layer of snow.

These birds displayed no sign of fear. Some of them settled near my feet, and I saw several of them walk into holes that resembled the burrows of the wild rabbit. I promptly wanted to handle one of these dainty lookings birds and at once tried to put my desire into practice. The burrow was about two feet, six inches in length and six inches in diameter. Groping inside, I felt a bird—and something else animate, cold and "wriggly." I withdrew this and held in my hand a tuatara, last living representative of a once flourishing order of reptiles, whose ancestors date from the Triassic period—200 million years ago!

This tuatara, a female 24 inches in length, was in good condition and after a squirm or two remained passive.

The tuatara and the petrel appeared to occupy holes in common amity—a quaint association of "the Beauty and the Beast."

From a light-keeper I learned that in early days tuataras were very numerous on Stephen Island but that one of the keepers had brought a cat with him. This cat took to the bush and produced kittens, and in course of time these produced other kittens. So it went on, cats reproducing themselves until the island swarmed with cats, which lived on tuataras and dove petrels. These cats were gourmets, for they ate only the breasts of the petrels. I saw scores of remains of petrels with breasts only missing.

In the hope of checking the killing of tuataras, I there and then undertook to pay the light-keepers two shillings and six-pence for each cat that they exterminated, plus a free supply of ammunition. On returning to headquarters I officially confirmed this undertaking and sent a supply of fowling piece cartridges to the lighthouse-keepers.

The killing of cats, however, did not keep pace with their breeding propensities, the cause assigned being that they remained concealed among rocks and dense brushwood during daylight and did their "dirty work" after dark. The cats denied themselves the "luxury" of poisoned mutton.

Cats continued to increase and tuataras to decrease.

Embodiment of horror

The native of New Zealand, the Maori, nurses a superstitious dread toward all lizards, large and small, but to his mind the tuatara is the epitome of superlative horror, the embodiment of aggressive cruelty—a "thing" of evil that could enter his body and eat his vitals!

When a tribe of Maoris contemplated making war, the important men sent delegates to a friendly tribe to solicit their aid in the fighting. If the solicited party agreed to an alliance, the delegates required that their *ariki*, or paramount chiefs, eat a small lizard in a raw state, in ratification of the pledge. This was the most fearsome and binding oath of integrity that could be administered.

On my return to Wellington from Stephen Island, I took seven tuataras with me, which ranged in length from 18 to 24 inches. I have not seen a tuatara that exceeded two feet in length. And I made a recommendation to the government in respect to protecting this exceedingly interesting animal by law. At a later date an Act of Parliament was brought into operation to provide protection for the tuatara; it is still in operation.

Pets

The feeding of tuataras in captivity presented a somewhat difficult problem owing to their predilection for insects. I frequently placed some raw beef in a minced condition in their cage, but they made no attempt to eat any of it. I placed a bundle of small earthworms in front of them, but they raised their heads in disdain. When one worm disentangled itself from the coil, however, my "pet" female, the tuatara that I caught first, watched it, and when it crawled near, she snapped it up. Very slowly it disappeared into her mouth. I thought that she had eaten it, but after the lapse of a few minutes, I saw the worm gently crawling out of her mouth, apparently much cleaner than when it went in.

I provided a metal pan of water, and into this the seven tuataras promptly piled themselves and remained there night and day, except when they were disturbed by a stranger, whereupon they would hurriedly scramble into their retreat.

After retaining the seven tuataras for several months, I presented five of them to the Museum of Natural History in Wellington, keeping the large light-colored female and a dark male that was about an inch shorter.

These I removed into my office, where I provided them with a sleeping box with a hinged cover. In daylight I frequently opened the lid to let them out for fresh air. The female always came first, dropping with a flop onto the carpet. They would squat without movement watching me, until some person entered the room, whereupon they would dart to cover in alarm.

This procedure was followed day after day, the female in front, the male a foot or more behind her. When she ventured a foot or so forward, he came half the distance; the nearer she came toward me, the farther the space between them. After many, many days the female reached a point about six feet away from where I sat; she was gradually advancing, he came to anchor!

The following afternoon the female came in a nonstop manner from her box across the room and rested herself on my right shoe, and there she remained until I replaced her in the box. For some four or five days she repeated this performance, the male well in the background. Her next movement was to crawl up my leg and squat on my knee. The next day was a "red letter day," for she climbed from my shoe to my shoulder without hesitation or halt. I liked her and apparently she liked me. She turned her head "cheek by jowl" to my face, and every day thereafter she would take her rest on my shoulder and submissively let me stroke her head and back.

One afternoon a man opened the door and entered my room. With lightning speed the tuatara dived head first into the V opening of my vest, concealing her head and wagging her tail on my face. The visitor inquired, "What's that?" I told him, and he said, "Cripes! I wouldn't have that thing on me for a thousand pounds!" I let the tuatara remain there until after the man had left the room, as she was afraid of strangers.

The native's fear

One day a very tall and strongly-built full-blooded Maori man came to the door of my room and asked, "You got the tuatara? I see him—*nei?*"

I asked him whether he was afraid of them. He answered, "I not know; I try."

When I placed the wriggling male on the carpet, the Maori darted for the doorway, stopped, slowly re-entered the room, standing as if ready for a quick "getaway." He gazed steadily at the lizard and then said, *"Py korry* (by golly), if I see that ferrar (fellow) in the push (bush), how I horror (holler) and run away!" That was an exhibition of genuine courage, as the Maori was contending against a pronounced superstition inculcated in his mind from childhood.

One dark evening I heard several gentle taps on the outer door of my room. I called out, "Come in." There was no response. I opened the door and saw three figures standing about ten feet away; three corpulent Maori women came forward. I recognized Rangi te Puni, widow of a Rangitira chief, who was one of the owners of the land whereon Wellington City now stands. Rangi told me that her friends would like to see the lizard. I answered, *"Hasre mai ki konei* (come in here)."

They answered in chorus, *"Kaua, kaua* (no, no), we are too *pr*ightened."

"Kaua, kaua (no, no), we are too *pr*ightened." They bent forward in crouched positions. I elected to show them the male tuatara, because of his violent squirming act when handled. At one glance, a trinity of screams broke out, and the three women scurried away in the darkness. Their courage was not equal to their curiosity.

The following morning Rangi who, by the way, wore as earrings two of her late husband's molar teeth, mounted in gold, returned. Standing nervously several feet away from the doorway, she asked, *"Toone,* you see the sausage?"

"Which sausage?" I inquired.

Rangi answered, "Last night the *nga wahine* (women) get the *pl*ight for the tuatara; run away; lose three-pound sausage for the supper."

Regretfully I told Rangi that I had not seen the sausage. A fright that would separate three fat women from three pounds of sausage must have been real.

Young

In the summertime I transferred the pair of tuataras to my home and provided a hutch for them in the garden. The female produced sixteen eggs. These I placed in a wooden box that was partly filled with fine sand, which I covered with a wet corn sack exposed to the sunshine.

In a few days short of three weeks, hatching began, and I saw that at least seven lizards had emerged from their cells. Hatching continued, and I allowed three more days for its completion. Early in the morning of the fourth day I went to examine the "incubator" and found it had been overturned and that every young lizard had disappeared.

A collie I possessed had had pups, and during the night she had eaten the brood of tuatara. *Aue! Aue!* Alas! Alas!

The mounted remains of the first pair of tuataras that I caught on Stephen Island in the eighties now repose in a glass case in my home in London.

NICKEL

Continued from page 77

to balance all the sulphur and into which almost 6% of nickel is sometimes intruded. A fresh surface has a bronze metallic luster, but it readily alters and tarnishes, so that most collection specimens fail to give a true idea of its appearance. Among the Sudbury deposits are other nickel minerals—pentlandite with 22% nickel, and polydymite with 53%—but they are not conspicuous.

In one method used in New Caledonia, the ore is mixed with calcium sulphate and smelted in a blast furnace to form a "matte," which is a complex mixture of iron and nickel sulphides. This product is very similar to that obtained by smelting the Canadian sulphide ores, except that there the matte contains copper as well as nickel, which adds to the complications. One interesting alloy, however, namely Monel metal, is smelted directly from the copper-nickel matte, the ratio of copper and nickel being adjusted during the treatment to produce the white, corrosion resistant alloy that has become popular in kitchen sinks. It contains about 70% nickel and 30% copper.

Pure nickel accounts for very little of the consumption. Some has been used in plating, and more in coins. The Axis nations have found the latter a readily available reserve during the present conflict. Italy managed in 1940 to get 1600 tons from the one- and two-lira coins and expected to get 2900 more from the smaller values. In 1941 the Czechoslovakian Government withdrew nickel coins from circulation. Some nations, however, use copper-nickel alloy coins. Our most familiar example is the five-cent piece, which contains only 25% nickel.

The world used 256,000,000 pounds of nickel in 1939 and proportionately more (the exact amount is a carefully guarded secret) in 1940, 1941, and 1942. Most nickel goes into steel alloys. Before the United States started to rearm, about 64% went into iron and steel combinations; today the percentage must be far higher because of priority allocations.

It is surprising what differences very small percentages of certain metals can make in the properties of steel. We saw that tungsten imparted great hardness, while manganese improved the workability. Low percentages of nickel increase the strength, ductility, hardness, and toughness. Higher percentages also affect the heat and corrosion resistance. Stainless steel, the alloy which gleams from the Empire State and Chrysler Buildings, is commonly known as "18 and 8," for it contains 18% chromium and 8% nickel. The toughness that is imparted to steel by nickel is also important at abnormally low temperatures, when steel becomes notoriously brittle. It is interesting to speculate that some of Herr Goebbels' troubles with the Russian winter may have been due to the Axis nickel shortage.

Chemically, nickel is closely allied to iron, and like it, is magnetic. Different combinations of these two metals result in exceedingly variable magnetic properties. The "Alnico" magnets, which will support 16 times their own weight, contain 20% nickel, 12% aluminum, and 5% cobalt. In electrical equipment where strength plus a lack of magnetism is desirable, combinations of iron and 20 to 30 per cent nickel are used, for these can be made nonmagnetic by heat treatment. Another alloy, with 36% nickel in iron, is practically without any expansion and contraction at atmospheric temperatures and is therefore useful for steel measuring tapes, watch parts, etc. Thermostatic elements are composed in part of this alloy. Another interesting alloy of iron, nickel, and cobalt has the same contraction and expansion properties as glass. This is used in making glass-to-metal seals in radio tubes and similar products.

Corrosion resistant surfaces for equipment handling chemical and food products are achieved by plating ordinary steels with pure nickel, nickel-steel, or nickel-copper alloys. The union between nickel and steel in these combinations appears to be very strong. In a test the steel broke under stress before separating at the nickel-steel juncture. Nichrome wire used in electrical heating equipment contains 80% nickel. And in the chemical industry other less expensive alloys with some iron are made for specialized uses. The classic "18 and 8" resists nitric acid, while Monel metal resists sulphuric acid.

German silver, now known as nickel silver, is the base for much silver plated flat and hollow ware. Since bowls and platters made of this also contain copper, lead, zinc, and tin, we cannot expect much civilian manufacture during the war. Bronzes in which a little nickel replaces some of the tin have been found to have a greater resistance to corrosion. White gold contains nickel and a little zinc with a 20% impurity necessary to give the color, so that even the purest white gold is not much over 18 carat in grade. Nickel is also an important ingredient in the Edison storage battery, which uses nickel oxide and iron in place of lead.

Truly the uses to which nickel has been put are many and varied. Much of the development has been due to research by the producers, who have endeavored to stimulate the use of nickel in peace. Today most of these new uses must give way to war demands, but afterward we can expect many new applications and extensions of the present ones.

Though Canada today supplies most of the world with nickel, this may not always be the case. Under present requirements, even the large existing production is insufficient, and additional deposits are being investigated. Prospects look good for nickel recovery from some Cuban nickeliferous iron ores and for the development of an extensive Brazilian deposit. Recent estimates indicate that nickel could be obtained from the Brazilian deposit more cheaply than the present price of 35¢ a pound, but 220 miles of road must first be built, a dam and plant erected, and all equipment supplied—not a feasible task in this crisis.

It is a long way from a known deposit to a productive mine, despite recent newspaper publicity regarding so-called newly discovered ores in our West. A few years ago, before Russia became a "democracy," American geologists, mining engineers, and economists derived considerable amusement from their method of discovering new ore deposits. All that was required, apparently, in order to transform a questionable deposit into vast ore supplies was a drill record and a couple of sharpened pencils. Most "new" American discoveries publicized today, alas, fall into the same category, though the Bureau of Mines should not be blamed for the deception.

Don't worry, however, about our nickel supplies. The Axis has practically none, and we shall have enough with what we are getting and can get from Canada. More could be obtained by proper reclamation of our scrap iron. It is estimated that 1,000,000 pounds of nickel could be reclaimed each month for use in steels. And don't take the publicized Arizona "deposit" seriously until you hear that it has actually produced some nickel, at cost or profit.

Photographing Radioactivity

By CHARLES H. COLES
Chief Photographer,
American Museum of Natural History

BACK in 1896, a French physicist, Antoine Henri Becquerel, was performing some experiments in photography when, disgusted with his efforts, he tossed a loaded plate-holder into a drawer. It lay upon a piece of mineral he had been using, and he left his laboratory for a weekend.

Upon his return, he decided to develop the plate in the plate-holder after all. Much to his surprise, a faint image appeared at the spot over which the mineral had rested. Apparently the mineral had in some way affected the photographic emulsion through the opaque protective slide of the plate-holder.

The mineral gave no indication of giving off light in the dark, so it must have given off an invisible radiation that could penetrate the dark slide on the plate-holder. This discovery opened the entirely new field of radioactivity which was to upset a scientific world that had just reached the comfortable conclusion that it knew all the fundamental facts of matter.

The radioactive minerals are usually salts of uranium—that heavy metal which is gradually and spontaneously breaking down into simpler elements. This disruption of its atomic structure is accompanied by the violent expulsion of charged atoms of helium, electrons, and an extremely penetrating radiation. The charged atoms, called Alpha particles, are responsible for the activating effects upon certain materials, causing them to glow.

Making the pictures

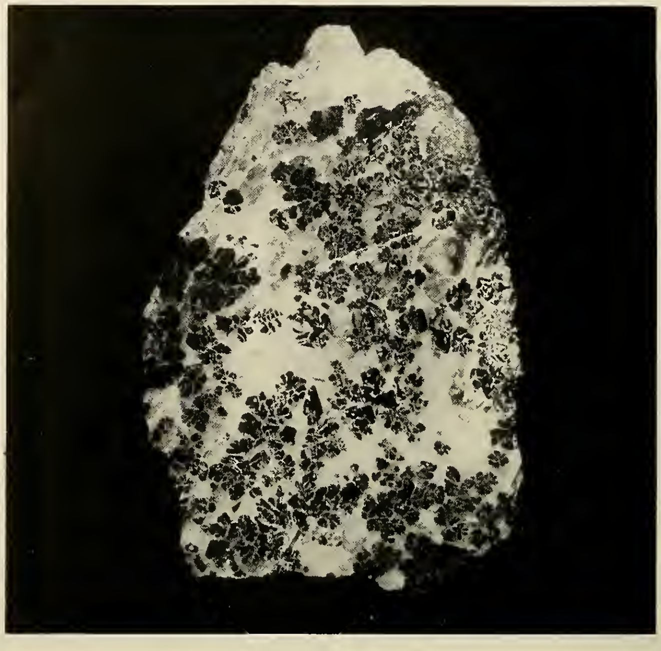
Uranium ores such as pitchblende, carnotite, and uraninite are all radioactive to greater or less degree, depending upon the concentration of the radioactive metals in them. The higher the percentage of the active metal, the quicker will these minerals produce their effect on a photographic film or plate.

To photograph these minerals under ordinary light involves no unusual methods, but to let them take their own picture is a novel experiment for most photographers. In a completely darkened room remove the photographic plate from its package and place it emulsion side up in the bottom of a box. Then put the radioactive mineral upon the plate, close the box, and snap a rubber band around it. It is important to keep the box closed tightly and prevent light from leaking in. Then set the box aside in a convenient place, preferably in a dark closet, for about a week.

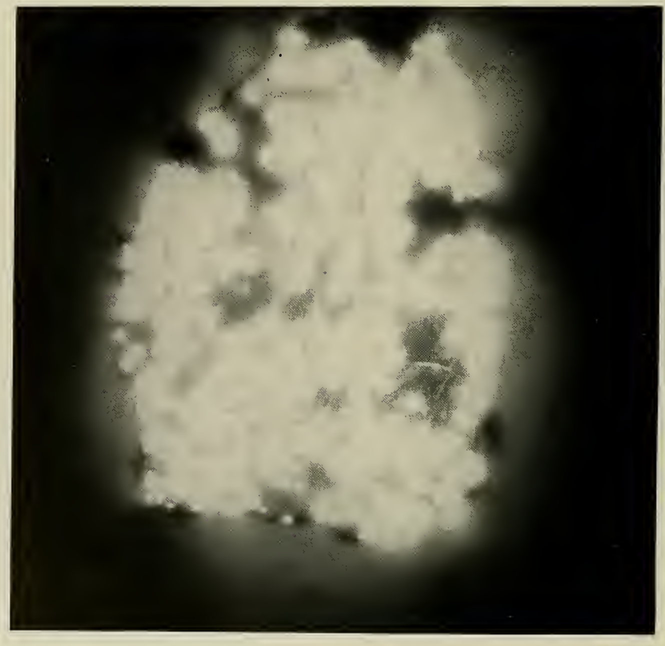
The film or plate, whichever is handier, can be of almost any kind. Medium lantern slide plates may be used for this type of work. The speed of the plate has practically no effect upon the length of exposure, so there is no need of using high speed emulsions. The concentration of the radioactive element in the ore does more to determine the minimum exposure time than the emulsion speed. Since this concen-

Continued on page 106

Photos by the author



Above: Uraninite photographed under normal light, showing the dark areas that are the radioactive uranium ore. *Below:* The same specimen photographed in complete darkness by placing it in contact with a photographic plate. Note that the dark areas are now the bright ones



Frozen flight

To stop action in a picture like this, it's necessary of course to use a high shutter speed. And it is also desirable to keep the camera 'stopped down' for good depth of field.

This picture was taken at 1/350th of a second at *f*8, *with a yellow filter*. The film that made the picture possible was Agfa Ansco Superpan Press.

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PHOTOGRAPHING RADIOACTIVITY

Continued from page 104

tration is not readily found out in terms of photographic effectiveness, it remains somewhat of an unknown factor. Hence, knowing that one photographic plate is twice as fast as another does not help much, if you do not know the strength of your ore.

The high-speed electrons, the Beta rays, are the ones that are chiefly responsible for the photographic effect. These have a relatively weak penetrating power but they will pass through several thicknesses of paper or cardboard. The thicker or denser the material they must pass through, the weaker will the effect be upon the photographic plate.

Interesting experiments can be performed if a larger source of Beta rays is prepared. The bottom of a shallow box about four inches square can be covered with uranium ore or, better still, with crystals of uranium nitrate, an inexpensive yellowish crystalline material obtainable at photographic supply stores. (After your experiments in radioactivity, this chemical can be used to tone your photographic prints in various colors.)

Place several metal keys, metal washers, coins, or other flat metallic objects upon the photographic plate which you wish to expose with the Beta rays. Then set your box of uranium nitrate crystals upon them. Keep this arrangement in the dark for a week. When the plate is developed, the images of the keys will appear as transparent areas where the Beta rays failed to penetrate. The spaces where no metal intervened will have been fogged by the radiation from the uranium salt.

Certain unscrupulous spiritualists have used radioactive materials in producing so-called "spirit photographs." Unknown to the victim of the hoax, a "spirit face" is painted in an invisible and strongly radioactive solution upon the dark side of a photographic plate-holder. In a short time the Beta rays from this material produce a foggy image on the plate. Then when the victim is photographed in the usual manner on the same plate, a ghostly face, claimed to be that of the deceased friend or relative with whom he desires communication, appears in a mysterious way on the plate beside his own.

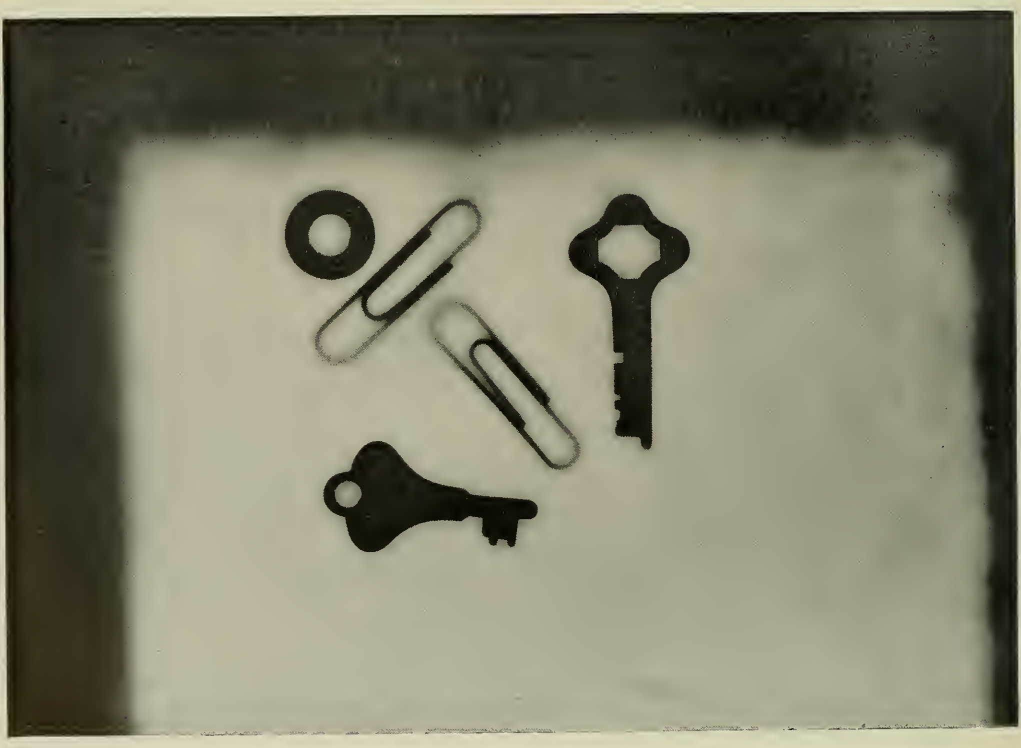
Industrial application

To the amateur, filming radioactivity is just another stunt, but industry has found a real use for this type of photography. Radium salts are a very powerful emanator of these Alpha, Beta, and Gamma rays. The Gamma rays are extremely penetrating and likewise extremely dangerous to living tissue. With proper care, this radium salt can be used to detect flaws in heavy metal castings. The radium salt in a lead container is placed against a casting so that a tiny hole in the lead container faces in the direction in which the rays are to penetrate. The lead sheathing prevents the rays from escaping freely in all directions and endangering those who handle it.

On the opposite side of the casting, a photographic plate is placed and left to expose for a matter of hours or days, depending upon the thickness of metal to be penetrated. After the completion of the time found by experience to give the best results, the plate is developed and examined. Blowholes in the depths of the metal show up clearly in the pictures as darker areas on the negative where more Gamma rays were permitted to pass.

The use of a complicated X-ray machine is thereby eliminated. In some places, such as inside a pipe, it would be impossible to place an X-ray tube, so radium comes to the rescue. Thus the accidental discovery of Antoine Henri Becquerel has proved of service to modern industry.

"Spirit photograph" of keys. This picture was obtained by placing a box containing uranium nitrate on the metal objects on a photographic plate that was shielded from all visible light. The plate is sensitive to rays which we cannot see and which penetrate opaque substances



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SUCCULENT PLANTS

- - - - - - - by E. J. Alexander

New York Botanical Garden, 50¢

A SERIES of articles from the Journal of the New York Botanical Garden, together with an article on the culture of succulent plants, has been brought together in a most attractive booklet. The numerous illustrations are from exquisite photographs made by Fleda Griffith and by the author. Here will be found cacti, century-plants, and other succulents of the American deserts; euphorbias, stone-plants, windowed-plants, aloes, and others of the Old World. The surprising beauty and variety of these plants, so well shown in this booklet, constitute one of the reasons for the lure of the desert.

Clyde Fisher.

BIRDS AROUND NEW YORK CITY

- - - - - by Allan D. Cruickshank

American Museum of Natural History, $1.75

THIS long-needed volume was compiled from a vast amount of data supplied by some hundreds of observers, among whom the author himself is one of the foremost. It contains an accurate summary of the available information on the bird life around New York City. The predecessor of this work by Ludlow Griscom, published in the same Handbook Series, is now out of print and has, for some time, been out of date owing to the rapid changes that have taken place in the local status of many birds. An important feature of Mr. Cruickshank's book is the account it gives of these very changes.

The area embraced has been somewhat extended in this present volume as is shown in the maps that form the end-papers. The text opens with an analysis of the avifauna of the area, first by ecological block, of which fifteen of the most important are briefly described, each with its birds of the different seasons. Numerous lists for the entire region then show different classes of residents, visitants, and transients, and in a detailed account of the changing seasons by months and fractions of months, the migrants are listed in their proper periods. Finally, the bulk of the volume is devoted to a discussion of each species, comparing its present with its former status and giving something of its local distribution and habitat, its nesting, and its time of arrival and departure, with emphasis on the normal condition rather than the exceptional.

The illustrations are fine examples of excellent photography for which Mr. Cruickshank is already noted. They follow the most modern style of printed illustration, occupying the pages to their full extent and requiring the captions to be placed on the opposite pages, not an unmixed advantage.

The volume should have a long and useful career and without question should be in the hands of everyone who is at all interested in the birds of New York City and the surrounding country.

John T. Zimmer.

ORNITHOLOGISTS OF THE UNITED STATES ARMY MEDICAL CORPS, Vol. I

- - - - - - - by Edgar Erskine Hume

Johns Hopkins Press, $5.00

IT requires only a glance at Colonel Hume's five pages of "Acknowledgments" to realize the number and variety of the sources on which he has drawn for the great store of information contained in this stately volume.

To ornithologists the names of Coues and Mearns will at once occur as eligible for inclusion here, but Colonel Hume has found 34 others whose service to the Medical Corps and the science of birds has won them a place in his hall of fame. One asks what part the innate interests of the born bird lover played in their selection of a calling? The result is an addition to birdlore and history most of which would have been unrecorded had it not been for the author's researches.

As we read the records of expedition after expedition into our then little known West, we are impressed by the fact that the men who served on them were pioneers in the best sense of the word. To unlimited hardships were added the dangers of entering a hostile country, and the excitement of collecting new specimens was accompanied by the possibility of encounter with savage foe. One recalls Bendire's account of his difficulty in disgorging a pair of hawk eggs he had hastily placed in his mouth when, on reaching a treetop nest, the discovery of watching Indians prompted a speedy descent and retreat.

Army men and civilians alike will welcome Alexander Wetmore's introductory tribute to Professor Baird, who was chiefly responsible for the appointment of men to the Medical Corps who, in addition to their professional duties, might also secure specimens for his young ward, the Smithsonian Institution.

F. M. Chapman.

THE HOUSE IN THE RAIN FOREST

- - - - - - - - - - by Charis Crockett

Houghton, Mifflin Co., $3.00

MRS. CROCKETT gives us an interesting and vivid description of the life she and her husband, a physical anthropologist, led in Dutch Guinea.

Sponsored by the Academy of Natural Sciences of Philadelphia, and accompanied by an ornithologist, another friend, a captain, a sailor, and a cook, they sailed from Gloucester, Massachusetts, to New Guinea on their 59 foot schooner, the *Chiva*. The company also included a parrot and a kinkajou. Mrs. Crockett was a lover of animals in no small way. The kinkajou was followed by a wallaby, who was always trying to crawl into bed with one of the company. A small tree-kangaroo was her main pet.

Mrs. Crockett is at her best translating to the printed page her sensitive, vivid impressions, whether they be of birds, of cockroaches, of the forest, or of the Papuan natives. The Madiks, among whom the Crocketts stayed for seven months in order to take measurements, were a gay people, and the author gives us understanding character studies of a number of them. The writer neither romanticizes native life nor her own life among the natives. She tells us about the pain and discomfort of malaria, the nuisance of rats, the constant company of cockroaches, the mud, and the weariness from long treks. But none of these really affected Mrs. Crockett's enjoyment of life.

Mrs. Crockett's training is obviously that of a physical anthropologist, but in an unpretentious way, she gives us a little ethnological data about the Madik people, interwoven with her personal story. We learn something, in a rather unorganized manner, about their origin myths, their clan organization, their economic system, their initiation rites, and about their beliefs concerning life after death. From the point of view of a social anthropologist, the reviewer finds her a bit naive because she describes customs which are quite common to many natives in Oceania as unusual or curious.

This book is one of the best personal accounts of the white man's life among a primitive people.

Hortense Powdermaker.

THE INTERNATIONAL PROTECTION OF WILD LIFE

- - - - by Sherman Strong Hayden

Columbia University Press, $3.00

DR. HAYDEN'S study of the many-sided subject of conservation relates to agreements between nations for the preservation of wild birds and mammals. It is divided into chapters that deal, respectively, with the protection of natural communities (such as African "big game" and New World birds), the responsibility for migratory birds that cross international boundaries, and the struggle toward wise use of valuable marine mammals, including both seals and whales.

This is a powerful and eminently civilized book. It is primarily a historical document, and yet in many noble passages it gives short shrift to the mean and narrow *pros* and *cons* as to why this or that element of the world's fauna is worthy of indefatigable human effort. While accepting the utilitarian point of view, the author far transcends it; he places the whole problem on an ethical plane that can hardly fail to appeal to men of good will.

Because of the incredible variety (and, incidentally, the stuffy lack of generosity) in human points of view, the obstacles to effective international conservation have, in the main, proved appalling. That Nero has been fiddling while Rome burns there can be not the slightest doubt. If the next few decades are to have any chance of improving upon the past, the forthcoming peace treaties must permit the animal life of the world to share a much larger proportion of the consideration usually reserved for mankind.

In a text that has been carefully considered and scrupulously edited, a few errors have, nevertheless, crept in. Fortunately, these have little bearing upon the author's thesis. For example, in comparing knowledge of European routes of bird migration unfavorably with that recorded for North America, Doctor Hayden has obviously been misled by published charts which are to a certain extent specious. The pretty representations of "flyways" to which he refers have only a general application, except as regards a few species of wild fowl. Most birds migrate on a "broad front," and the European routes are actually known in greater detail than our own, because of the far larger number of banding records in the Old World.

R. C. MURPHY.

VOLES, MICE AND LEMMINGS

- - - - - - - - by Charles Elton

Oxford University Press, $10.00

THE author defines the title as "Problems in Population Dynamics," and this book, of nearly 500 pages, is an exhaustive and scholarly account of the fluctuations in the numbers of these small rodents, as well as some other animals.

Plagues of mice received attention in the Old Testament, when "Mice were generated and 'boiled over' the towns and fields in the midst of that region and there was a confusion of great death in the land. Elton devotes an interesting first chapter to vole and mouse plagues in ancient history. Eventually he documents all records for these phenomena.

Periodic concentrations of mice levy heavy tribute upon vegetation. They become an economic menace and much study has been given to methods of control. Despite a periodic increase in the numbers of mammals and birds preying upon the mice, these natural enemies cannot hold the mice in check. The classical example of this building up of numbers until the country is too small to contain them is the lemming of Scandinavia. The mass movement is of such proportions that, although great numbers are killed by accidents and gathering enemies, "in 1868 so many swam out into the inner parts of Trondhjem Fjord that a steamer took a quarter of an hour to pass through them."

One of the author's principal purposes in studying these fluctuations in rodent populations is to discover causes and underlying patterns of this periodicity. The story is not a simple one to be fully explained by favorable food cycles. "So we are left, ..., with a good many hints of some great cosmic oscillation, expressing itself in periodic upheavals in the biotic community, but we still lack the full key to the problem."

This book will stand for many years to come as an authoritative text and standard reference on the subject it so ably covers. This reviewer believes the author would have made his book more useful if he had summarized. The reader is left without a résumé of just what Elton believes himself.

H. E. ANTHONY.

THE AGELESS INDIES

- - - - - - - - by Raymond Kennedy

John Day Press, $2.00

THIS book comes at a time when we know it is needed. The pity is that there were not a dozen books of this sort on sale in America ten years ago. Now, at any rate, we know that we need information about the Netherlands East Indies and about colonial administration.

Doctor Kennedy's story of this region is an interesting one. The Dutch had wisdom and took the trouble to study their native peoples—, yet the islands fell to an invader as easily as Holland itself.

The Dutch were among the first to attempt "indirect rule." They were not hungry for the pomp of power and took no joy in coercion, but they wanted peaceful control. They therefore preserved the native systems of administration and installed their own officials as "advisors" to the native princes. They touched the native system only at the top and did not, like the British, patrol the native villages, instructing and interfering at the "grass-roots" level. Doctor Kennedy says that the Dutch policy was dictated by economics, and that is certainly part of the story. He respects the Dutch. I, who candidly like them, suspect that another reason for "indirect rule" was that the heavy and unworried Dutch just disliked walking.

Under "indirect rule" compulsory labor on the roads, which existed in Indonesia long before the Dutch came, persisted. And European education, though offered, was not pressed on the natives. Doctor Kennedy says that in the nineteenth century the Dutch positively delayed education, but they no longer did this in 1936-39 when I was there. Certainly pro-Dutch feeling was not industriously promoted, and the natives remained politically naive. They were content to be well governed. And the islands fell. If uninterrupted, the patient system of the Dutch might have enabled the natives to take their place among the nations of the world, in perhaps another hundred years. The Dutch knew how to let things grow without forcing them, but we have to solve a more difficult problem—how to stimulate and educate without coercion.

GREGORY BATESON.

NO LIMITS BUT THE SKY

- - - - - - - - by Mary B. Kidder

Harvard University Press, $3.00

THE Preface of this book was written by the author's father, the well-known Director of the Museum of Comparative Zoology at Harvard, who takes justifiable pride in the simple diary of his daughter. The book might have been titled, A Peruvian Diary, for it is just that, and is based upon two archaeological expeditions with her husband to the land of the ancient Inca empire, one in 1937 and the other in 1939. It happens that the author's husband is an archaeologist of the second generation, his father being the well-known student of the ancient peoples of our Southwest.

These young people, however, are not living on the reputations of their famous fathers, but are abundantly able to stand on their own feet, as is made clear by this account. The diary was evidently not written with the idea of publication, and it has not been dressed up for that purpose. It contains no technical scientific archaeology, but it is a human day-to-day story of their experiences in this most fascinating country. Mrs. Kidder tells how they traveled, where they went, what they saw, how they lived, and how the native Indians lived, giving just the information that every fellow-traveler would like to have.

It is the more interesting to this reviewer because, while leader of the American Museum Eclipse Expedition to Peru in 1937, his trail crossed theirs. Among the places described are: Trujillo; Chan-Chan, the largest ruin in Peru, covering eleven square miles; Hacienda Chiclin and the famous Larco Museum; Lima, with its National Museum, and the University of San Marcos, the oldest university on the American Continent; Pachacamac, with Dr. Julio C. Tello, Peruvian archaeologist; Arequipa and the Quinta Bates; Cuzco, the Capital of the ancient Inca Empire; Macchu Picchu; Lake Titicaca; and Tiahuanaco.

The book will be welcomed by all those

who have traveled in Peru and by those who hope to visit this land of enchantment.

CLYDE FISHER.

ANIMALS ARE MY HOBBY

------ by Gertrude Davies Lintz

Robert M. McBride and Co., $2.75

FEW men and women are endowed by nature with both a great love of animals and amazing courage and confidence in dealing with them. Mrs. Lintz's abundant possession of these qualities has enabled her to care for and train a succession of wild animals whose strength and unpredictable behavior would cause most people to hesitate before assuming responsibility for these interesting individuals.

Mrs. Lintz's early and extremely successful venture in the breeding of St. Bernard dogs gave her experience in the systematic and scientific feeding and schooling of young animals, which prepared her for the later hobby of rearing chimpanzees and gorillas. Between these two major projects there had been a succession of other pets—from pigeons and rabbits, great-horned owls and a "dragon lizard" to a beautiful but untrustworthy leopard.

The chapters on St. Bernard dogs are quite absorbing, with their tales of champion after champion, some attaining the almost incredible weight of 250 pounds. However, the chimpanzee and gorilla tales will probably prove most thrilling to the majority of readers. To her scientific kennel, feeding, and training routine, Mrs. Lintz added good nursery-school techniques in learning through play. Those almost human creatures, Gargantua of circus fame and Massa, now in the Philadelphia Zoo, were her two most famous charges; both of these animals were relinquished from her care only when their great size and marvelous strength made them too great a responsibility for a household.

Mrs. Lintz tells many tales of appealing little chimpanzees with lovable baby traits, who grew up under her care to be just as difficult in their adolescent years as any human children.

. YVONNE A. RAVEN.

THE CONSERVATION OF NATIONAL RESOURCES

------ by George T. Renner

John Wiley & Sons, Inc., $2.75

WITH the tremendous but necessary waste of resources caused by the war, we can only hope that the public, now more conscious than ever before of the individual responsibility for the saving and wise use of materials, will profit by this experience when the war emergency has passed. American teachers of every kind and degree must realize the basic importance of conservation.

Of all that has been written on resource conservation—from technical works, textbooks, and teachers' manuals to popular editions—this is the first standard-sized volume directed specifically toward the teacher that considers in detail the educational purposes, problems, and methods involved in teaching resource conservation.

The Conservation of National Resources will not replace Van Hise's classic presentation of conservation data, nor the newer book by Parkins and Whittaker. These present the facts and suggest corrective measures. Renner explains why and how the school should use such material. The first of the three sections of the book is devoted to the evidences of resource waste, the growth of the conservation movement, and the necessity for an educational attack on conservation problems. Part Two is an outline of the natural and human resources of our country, their uses, related problems, and suggested remedies. In Part Three the materials for conservation education are listed and evaluated, local educational facilities are indicated, and problems of curriculum construction are discussed in practical form. Here we find that conservation cannot be treated as a "subject," but rather as a point of view and a way of living. It can be as logically taught in relation to nature study, science, and agriculture as in the social sciences.

Renner's book places a valuable tool in the hands of our teachers. Their own wisdom and foresight will determine the extent to which it fulfills its purpose.

ETTA FALKNER.

THE FACE OF SOUTH AMERICA

------- by John Lyon Rich

American Geographical Society, $4.00

AERIAL photography, and elaborate map-making based upon it, have become commonplace. Bulky and expensive professional equipment is ordinarily used in exposing the negatives and in the subsequent cartographic translation of the data. It has remained for Professor Rich to show that the "aërial traverse," involving precise geographic location of every view, can be successfully carried out with a miniature camera operated through the windows of commercial planes. After experiments along air lines in the United States, the author recently extended his field to the grand tour of South America, and this beautiful and revealing volume is the result. He calls it a "book of pictures," but it is only fair to state that the route maps, the explanation of method, the brilliant interpretive comments on each of the 300 photographs, and the incidental light cast upon historical, agricultural, industrial, and other human concerns provide at least half the treasure.

In sequence, the photographs sample only a narrow band of territory around and across a continent, and yet the land types are almost all-inclusive. Equatorial rain forest, river systems, elevated and sinking shore lines, broad and shallow or narrow and trenched coastal platforms, delta and dune, savanna and desert, marsh, tablazo, scarp, shield, and mighty mountain ranges of various ages all pass in rapid review. Man-made modifications include reflections of the remote pre-Incaic past as well as contemporary land use, while at the same time many future possibilities and desirable or essential trends are clearly indicated. Particularly dramatic are the opportunities noted in figure 95 and the related text, which point out one of the greatest water-power resources in the world because of the presence of permanent rivers on the Brazilian plateau which are yet close enough to the escarpment to have part of their water readily short-circuited into a drop exceeding 2000 feet.

R. C. MURPHY.

OPEN FOR YOU

$1600 in Prizes

Offered by

Natural History Magazine

See Page 58

BYWAYS TO ADVENTURE

-------- by Edwin Way Teale

Dodd, Mead & Company, $2.75

MR. TEALE is becoming justly famous for his aid to nature hobbyists who, like himself, spend the major part of their free hours becoming more familiar with the world out-of-doors. This current guide is excellently organized and is by no means merely a collection of miscellaneous information. Step by logical step, the author wanders with discipline through activities which include bird watching, weather observations, astronomy, insects, reptiles, mammals, and the world of plants. He does not neglect geology or the "Wonderland of the Microscope." His outlook on wild life conservation is sane and could well be followed by many who tend to go overboard on this subject. Excellent bibliographies serve as an up-to-date library list for any nature student. A particularly stimulating chapter concerns "The Outdoors Brought Indoors—Museums." Mr. Teale presents a list of outstanding museums both large and small, state by state, and provides sound advice for collectors who wish to spend long winter evenings studying and preparing for exhibit, objects found in the open.

The following point of view struck us as being particularly worth-while at this time: "It is a significant fact that in 1940 more people visited the natural history museum in London than had entered its doors on any previous year. During the same twelve months of shock and uncertainty, the membership of the American Museum of Natural History, in New York City, rose to the highest point in the records of the institution."

A valuable asset for either calm or troubled hours is an interest in the natural world about us. Hobby trails in the field of natural history are byways to quiet but real adventures. From boys with energy to spare, to retired professional men with time on their hands, numerous people have found opportunities for fun and relaxation—and sometimes achievement as well—in nature avocations.

W. H. CARR.

AN ENGLISH 13TH CENTURY BESTIARY

- - - - - - by Samuel A. Ives and
Hellmut Lehmann-Haupt

H. P. Kraus, New York, $1.85

ONE of the most popular books of all time is now almost forgotten and its original text is lost. It was written by someone whose pseudonym was Physiologus and who perhaps lived in Egypt in the second century. The medieval bestiaries were made up largely of quotations from Physiologus, accompanied by quaint and highly imaginative paintings of animals. The text drew parallels between the supposed habits of these animals and the morals of ancient and medieval Christianity.

The volume here under review is a technical discussion of a manuscript bestiary, the peculiar interest of which is the light that it throws on mass production of books before the invention of printing. Lehmann-Haupt believe that this was a model book used by medieval scribes as a guide for copying. In many of the illustrations the outlines of animals have been pricked as if to make a perforated pattern. This pattern may then have been used like a stencil to transfer the picture to another volume, after which the painting could be quickly filled in by hand. The discovery has unusual interest for bibliophiles and gives additional evidence of the great popularity of the medieval version of natural history.

G. G. SIMPSON.

DESERT WILD FLOWERS

Revised edition

- - - - - - - by Edmund C. Jaeger

Stanford University Press, $3.50

THE lure of the desert is universally recognized, and every traveler is no doubt surprised on his first visit to these arid regions by the abundance of flowers and trees, especially at certain seasons of the year. Everyone is intrigued by the adaptations of plant life to this land of little rain. And everyone wishes to know the names of the conspicuous plants at least. The naturalist, moreover, wishes to be able to find out the name of any and every plant that he meets.

Here is the book to give that information. It is based upon 25 years of tramping and sketching by an enthusiastic lover of the wild flowers of the desert, who is also professor of biology in Riverside Junior College. Seven hundred and sixty-four desert plants are described and illustrated. There are many photographs, but by far the most of the illustrations are line drawings, nearly all made from living plants. As pointed out, the line drawings show better than any photographs (even colored ones) the details of structure which make identification possible. To draw so many plants in their native habitat, the author tells us, involved traveling over 30,000 miles of desert roads and trails.

The book emphasizes the fact that the deserts are not as barren as commonly believed, for there is not a month in the year when the far Southwestern American deserts are completely without flowers. Not only is information about the plants given, but scattered all through the book are many interesting bits of general natural history, such as the relation of birds and insects to various plants, the uses of parts of various plants by the Indians, the work of pioneer botanists, and the like.

A key designed for the quick identification of unknown plants found in these deserts is included, having been prepared by Ruth Cooper, botanist of Riverside Junior College, Riverside, California.

CLYDE FISHER.

AN INTRODUCTION TO THE PLANT SCIENCES

- - - - - - by William C. Darrah

John Wiley & Sons, $2.75

THE publishers of this book have recently printed a series of six text-books (survey courses) of the sciences, namely, physics, chemistry, the body functions, astronomy, biology, and earth sciences. Botany was not given separate treatment in this group of books, but here is a volume by a Harvard University professor that logically fills this gap. It was written for students who will take a half-year course in botany, and who presumably plan no additional work in the field.

It was not designed as an aid in learning to identify or classify plants, but is a text-book of plant biology. Plants are treated from the standpoint of plant functions or plant physiology—from the standpoint of biophysics and biochemistry. The book is carefully written and well illustrated, and we are given the modern conceptions of evolution, variation, mutation, and heredity in plants.

Growth and reproduction are treated, as well as transpiration as the cause of the ascent of sap, the distinction between respiration and photosynthesis (often not clearly presented in text-books), soil-erosion and its control, and the origin of plants as indicated by the fossil remains. Altogether it is an excellent text.

CLYDE FISHER.

PASSPORT TO ADVENTURE

- - - - - - - by Lewis N. Cotlow

The Bobbs-Merrill Company, $3.50

SHOULD a young man who longs for travel and adventure grasp the first opportunity; or should he apply himself to business, and travel after his fortune is won? Lewis Cotlow shows admirably that both ways may be right. After the armistice of 1918 he was a cocky young supercargo on American ships bound here and there around the world. When supercargoes were dropped, this one returned to New York and entered the insurance business.

No extensive travel was possible for six years, and then Cotlow stuck to tourist routes until 1937, when he realized a burning ambition to see Central Africa. An Imperial Airways plane carried him

Natural History

ILLUSTRATIONS

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Above illustration—Nile River Group—Detail showing Antelope
Akeley African Hall—American Museum of Natural History

from Rome to Lake Victoria and a tour of four months in the eastern Congo. Airplane, automobile, and new color-cameras, plus his own vast enthusiasm, captured for Cotlow a remarkable array of Africa's most interesting features, all in one vacation of an efficient business man.

He visited with pygmies and giant Watusi, studied the big game of the Kivu without a gun, and encountered a band of gorillas on Mt. Bugalamisa. In Kenya Colony and Tanganyika Territory he photographed lions at incredibly short range. On his trip home he found a way to visit Seville during the Spanish war.

In Yucatán a year or so later, our author yearned to go on to the land of the Incas. This dream came true in 1940, and again the airplane and auto whisked him to the high Andes, Quito, La Paz, Cuzco, and Manchu Picchu. Cotlow wanted to see Indians, and did. The Colorados of Ecuador painted him bright red like themselves. The Huambisas of the Marañón Valley forebore to add his head to their collection. He was much nearer death when an old airplane engine failed momentarily over the forest.

Just now the war seems to have voided Cotlow's passport, but perhaps the Navy may yet send him on still more adventurous errands.

James P. Chapin.

THE COVER THIS MONTH

September NATURAL HISTORY 1942

Nickel · Talking Drums of Africa · Quinine and the War

Raymond B. Fosdick: A Malarial Invasion · Migration

FIFTY CENTS

This beautiful and active little creature is a Squirrel Monkey, of the genus *Saimiri*. It is reproduced on the cover almost twice natural size, being scarcely more than ten inches in length, exclusive of the thirteen-inch tail. The tail is non-prehensile, and the monkey often winds it around its body when at rest. However, the squirrel monkey is an extremely active animal and spends much time scampering about the tree tops far above the ground. These monkeys are native to South and Central America and are often kept by the natives as pets, being very playful and good-humored. They feed on fruit and insects.

Dogs for Defense

The Army has found that a sentry dog will take the place of six to eight men, thus releasing that many soldiers for service elsewhere. Obviously a dog can detect a saboteur in hiding or on a dark night when a human never could. Sentry dogs are needed in the Army to guard trucks, tanks in depots, airplanes, warehouses, munition dumps, and so forth.

The Germans are using 50,000 sentry dogs and are now supplying the Japanese. Russia also has 50,000 attached to their Army. We have only 67 in training, and General Gregory wants at least 2500 by the end of the year, followed by 5000.

So line up all the suitable dogs that you can so they may be immediately put in training. Let's not have "too little and too late" in this effort. Any purebred medium size dog will do. The training period is usually two months, with a minimum of one and one-half hours a day. A large number of trainers have already volunteered and are training Army sentry dogs. You can help by giving a dog or your services as a trainer. Write to: Dogs for Defense, 22 East 60th Street, New York, N. Y.

Dogs given for this service become the property of the U. S. Army and will not be returned. When the war is over they will be kept, bred, and trained for these duties.

Any purebred dog of either sex, physically sound, between the ages of one and five years, with the characteristics of a watch dog is likely to pass as suitable. Pedigree papers are not necessary. The dog must be larger than a fox terrier and smaller than a St. Bernard.

Obedience

Heel: On command, the dog must stay at heel on the left side of his handler, whether on or off lead. Absolute steadiness is necessary, rather than perfection of position.

Stay: The dog must stay, on command or signal, either in a sitting or down position. He must demonstrate instantaneous response to the command and should show no inclination to become restive.

Out: On this command the dog must go out and search in the direction indicated by the handler.

Come: The dog must return to his handler on command, regardless of various distractions.

The dog must give warning at all times of the presence of strangers by coming to attention, barking, or growling. He need not be vicious or want to bite strangers. In fact, such dogs might actually be dangerous in this work as they might go for the corporal of the guard, officers of the day, etc. The sentry dog is merely supposed to locate strangers and give warning. If any blood is to be spilled, that is what the soldier accompanying the dog has his gun for.

All commands used in training must be preceded by the dog's name. The trainer must realize he is training the dog to be worked by someone else, and no one should be permitted to make friends with the dog except the handlers. Some work at night during the latter part of training will be required.

Obviously the sentry dog must not be gun-shy. In finding out if a dog is gun-shy you should not fire the gun off right next to him. Have somebody go quite a distance away. At each shot reassure the dog and pet him, until the gunner has gradually come quite close. Most gun-shy dogs have not been properly introduced to gun fire.

As soon as you can locate prospective dogs for Army work, send full particulars to your regional director or to Dogs for Defense, 22 East 60th Street, New York City.

W. Newbolo Ely,
Regional Director for Pennsylvania.

LETTERS

Continued from page 58

service who cannot otherwise receive the Magazine.—Ed.

* * *

Sirs:

I have now read two copies of your magazine and wish to say that it is the most interesting I have had the pleasure of reading. It is well worth the subscription price. . . .

The following quotation from a letter written me from Sydney, N. S. W., may be of interest:

"As the years go by, the family finds more and more interest in Natural History, and I really believe that it improves from volume to volume. I have just finished reading the February number, which arrived a few days ago, and every article but one was of distinct interest to me. Now and again an article will appear that is of outstanding merit. I have greatly enjoyed George Gaylord Simpson's series on the evolution of animals, and consider the series on strategic metals something of great value. Surely there could be no better way of teaching geography than . . . through this method. R— [a son] used Natural History to provide material for an essay on 'Earthquakes' and found difficulty in breaking off his search for information."

Cincinnati, O. Gustov Pheiffer.

* * *

Sirs:

It is not hard to see why I have continued to make Natural History my annual Christmas gift. For a time . . . I offered my friend a choice of American magazines, but no other was ever suggested, and now I automatically renew Natural History.

Philadelphia, Pa. Frank C. Walsh.

* * *

Sirs:

Your magazine is a work of art, and the beauty of it thrills me every time I receive a new copy. It is priceless, and I consider it a very great privilege to be allowed to renew my subscription.

(Mrs.) John G. Rodgers.
Buffalo, N. Y.

October **NATURAL HISTORY** 1942

Design for Swimming · Attu · Modern Audubon in Mexico

Rainbows of Rock · Mercury · Libyan Desert Exhibit

VOLUME L. No. 3

FIFTY CENTS

MEMBERS' CONTEST

$1600 IN U. S. WAR BONDS

to be given to 31 Museum Members who secure the greatest number of new subscriptions

---

The Museum, in war time as well as peace time, symbolizes a vivid reflection of Truth and Human Enlightenment which our liberties have granted us.

Our armed forces are defending this heritage. You can encourage wider knowledge and enjoyment of these American privileges by introducing NATURAL HISTORY to your friends and securing their subscriptions.

Act Today

A fund of $1600 in U. S. War Savings Bonds (face value) has been donated by friends of the Museum to be distributed among those who obtain the greatest number of new NATURAL HISTORY subscribers.

Membership in the Museum is included with each subscription.

Prizes

$500 in U. S. War Savings Bonds for the highest number of subscriptions.

$300 in U. S. War Savings Bonds for the second highest number.

$100 in U. S. War Savings Bonds for the third highest number.

28 prizes of $25 each in U. S. War Savings Bonds for the 28 next highest numbers.

Rules

1. This contest is limited to NATURAL HISTORY Magazine subscribers in the United States. Employees of the American Museum of Natural History and their families, and professional magazine solicitors, are not eligible.

2. To qualify for the contest, you must send in at least three new subscriptions. Each contestant sending in five new subscriptions will receive a one-year renewal of NATURAL HISTORY free.

3. Payment of $4.00 must accompany each subscription.

4. Renewals will not be considered new subscriptions.

5. In case of ties, the tying contestants will be required to submit a letter of not more than 50 words setting forth the merits of NATURAL HISTORY Magazine, and the award will be made to the contestant submitting the best letter.

6. All subscriptions must be received on or before October 10, 1942, or bear the postmark of that date. Winners will be announced in the November issue of NATURAL HISTORY.

7. Envelopes containing subscription forms may be procured from the Membership Secretary.

Contest closes October 10th.

Address all communications to:

Membership Secretary, The American Museum of Natural History,
New York, N. Y.

Natural History
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COLOR PROCESS, BLACK AND WHITE, BEN DAY, LINE

Above illustration—Nile River Group—Detail showing Antelope
Akeley African Hall—American Museum of Natural History

CHARLES FRANCIS PRESS
NEW YORK

LETTERS

Sirs:

In an article entitled "The Largest Known Crocodile" by Barnum Brown in the May, 1942, issue of Natural History, the following statement occurs: "And the largest known fossil tree, measuring fourteen feet in diameter, is from this region."

With due respect to Barnum Brown and the state of Texas, I affirm there is a larger fossil stump or tree, in Montana.

In the northwest corner extension of Yellowstone National Park, on the summit of 9,000-foot Gallatin Range, at the divide between Daly Creek on the Gallatin side and Tom Miner Creek on the Yellowstone side, is a fossil stump approximately nineteen feet in diameter, sixty feet in circumference, and seven feet high above ground.

I am enclosing a photo of the stump I took about 1909 and another showing the Daly Creek basin and part of Gallatin Range, the location of the stump being marked by X. The only way to these fossil trees is by foot or on horseback.

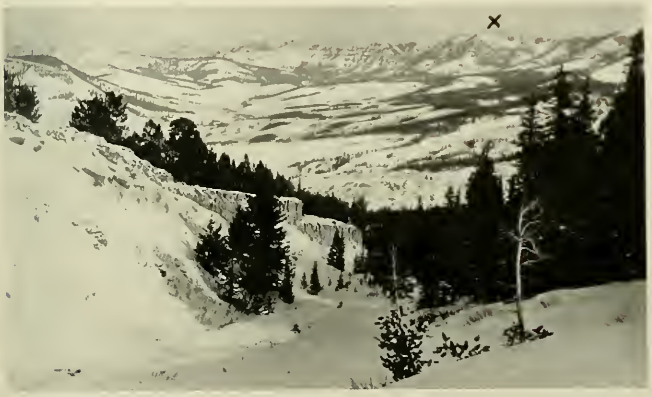
Many large pieces have split off and are lying about. The stump is supposed to be a prehistoric Sequoia. The camera case shown is 9 x 12 inches.

I have been a subscriber to Natural History for many years, and it is my favorite magazine.

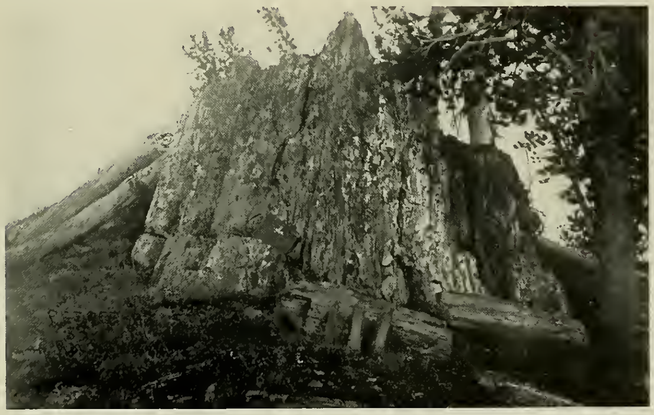
C. A. Kinsey.

Belgrade, Mont.

With apologies for the oversight, Natural History transfers the honor to Montana, where Mr. Kinsey's stump is indeed 18½ feet in diameter by actual measurement.—*Ed.*



Far up in the Gallatin Range, Montana can claim an 18½-foot fossil tree stump, at the point marked X above. It is accessible only by foot or on horseback



Mr. Kinsey's close-up shows the fossil stump and a number of the large pieces that have split off

Continued on page 166

LONGINES
the most honored watch
for a
DOCTOR

This handsome watch is one of several Longines models with the easy-to-read sweep-second hand so much appreciated by doctors and other professional men. Not all Longines jewelers have the watches illustrated here, but every Longines Watch has the Longines world-honored "Observatory Movement".*

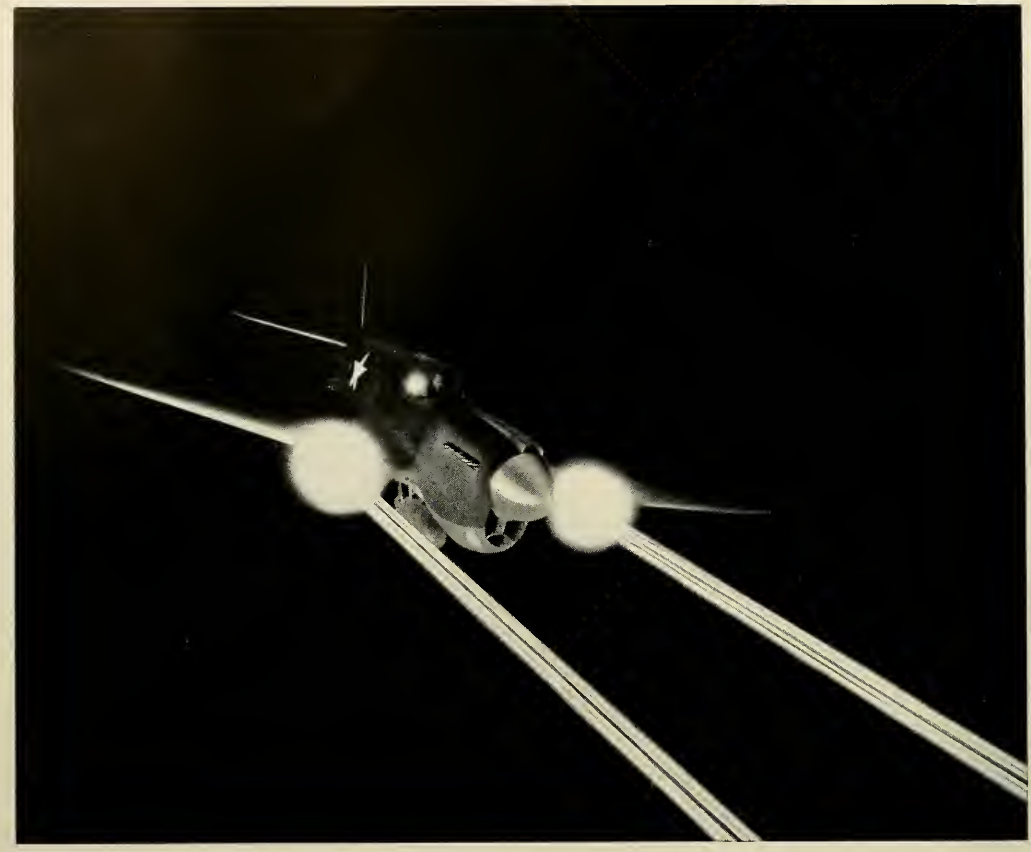
Longines

THE WORLD'S MOST HONORED WATCH

The established prestige of Longines Watches has resulted in a demand today greater than necessarily restricted production. Your Longines jeweler will show you the Longines Watches that are available, and all have the dependable Longines "Observatory Movement." Longines Watches have won ten world's fair grand prizes, 28 gold medals and more honors for accuracy than any other timepiece. See also the Wittnauer watch, a companion line outstanding for value at a moderate price—product of Longines-Wittnauer Watch Co., New York, Montreal, Geneva.*

*Trade Mark Registered U. S. Pat. Off.

Longines Watches have won 10 world's fair grand prizes, 28 gold medals



He's firing telephone wire at a Zero!

This fighter plane, with its six wing guns spitting fire, uses up enough copper every minute to make several miles of telephone line.

That's the right use for copper now — and it's the reason why we can't continue to expand our facilities to take care of the expanding Long Distance telephone traffic.

Right now, our lines are flooded with Long Distance calls. Most of them have to do with the war — they must have the right of way.

Will you help us keep the wires clear for war calls —industrial calls that send a plane down the assembly line — military calls that send it into the air against the enemy?

You can do it by keeping your own calls as few and as brief as possible. And you'll be bringing Victory that much nearer.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

Frederick Trubee Davison, President
Albert E. Parr, Director

VOLUME L—No. 3 ★ ★ ★ ★ ★ ★ **OCTOBER, 1942**

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From a Kodachrome by Ralph Calvert, taken near Moab, Utah

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You will find Natural History Magazine indexed in *Reader's Guide to Periodical Literature* in your library

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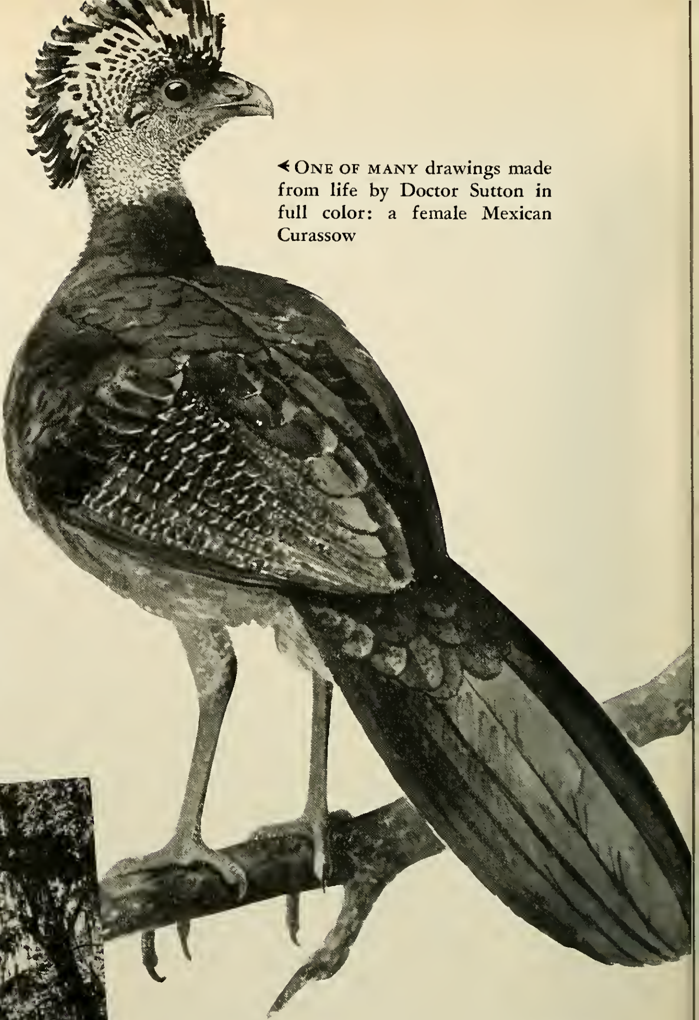
A MODERN *Audubon* IN MEXICO

An enchanting tropical river beckoned with many unsolved problems in bird study, and four men set out to explore its mysteries



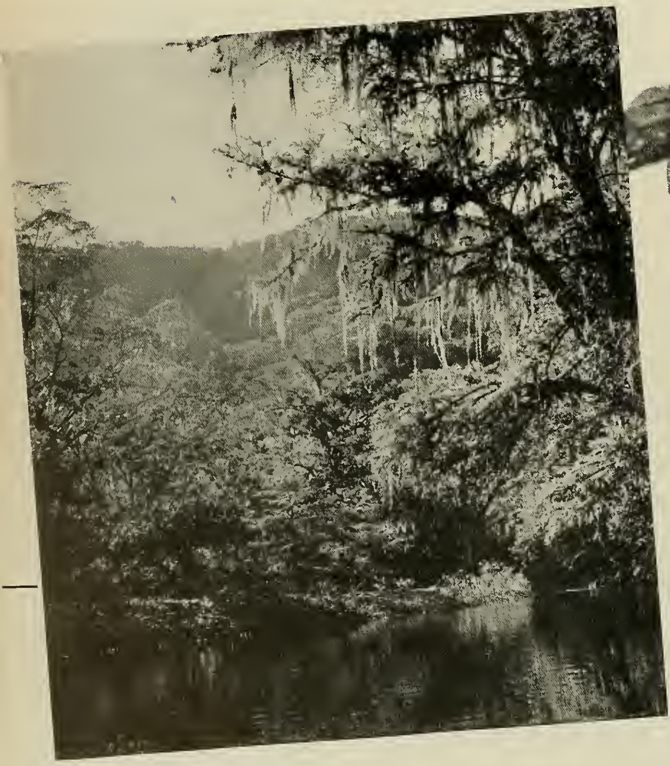
◂ ONE OF MANY drawings made from life by Doctor Sutton in full color: a female Mexican Curassow

By GEORGE MIKSCH SUTTON*

Photographs by
OLIN SEWALL PETTINGILL, JR. *and* ROBERT B. LEA

THREE hundred and seventy-five miles south of the border town of Laredo, Texas, the Mexican highway crosses a quiet little river. The water is green and not perfectly clear. On very hot days a thin web of light seems to hang low over it. The river moves slowly, as if loath to leave the moss-draped cypresses whose shadows rest so gently upon it.

The sign at the bridge reads "Rio Sabinas." But who could deduce from these words that long-tailed



◂ UP AND DOWN the lovely Sabinas the four-man Cornell University-Carleton College expedition worked during March, April, and early May. They listed well over 200 species of birds

The artist putting the finishing touches on a life-size portrait of a Squirrel Cuckoo in the field headquarters. The paint box was used for years by the celebrated artist Louis Fuertes, who gave it to Doctor Sutton

green and gold macaws fly up and down the valley every morning and evening, and that spotted jaguars rear their pretty kittens in impenetrable bamboo brakes back from the cleared lands?

I became acquainted with the Rio Sabinas in March, 1938, when I spent four feverish days collecting birds there with a Carnegie Museum party. We lived at W. H. Bensel's Rancho Rinconada, a partly cleared stretch of flood plain with a one-storied house a mile or so west of the highway.

I fell in love with the Sabinas the instant I saw her. She was so beautiful and clean and cool. The sounds she made were exactly the right sounds. Her shallows were friendly, her shadowy deeps restful to the eye and soul. Even the Vermilion Flycatchers that snatched insects from her glass-smooth surface were the more brilliant because she herself was so delicately green. Standing beside her, I had the strange sensation of being quite comfortable upside-down, so perfectly did she mirror her banks, the gray-boled cypresses, and white piles of clouds.

The Sabinas was a truly Mexican stream. Her whole length lay south of the Tropic of Cancer. Her birds, mammals, bright butterflies, and lizards were austral beings, many of them living here at the northernmost frontier of their range.

Why did they live here? What was it about the Sabinas, or the mountain or forests, that gave them exactly the home they required? When I bade the river farewell three years ago I knew these ques-

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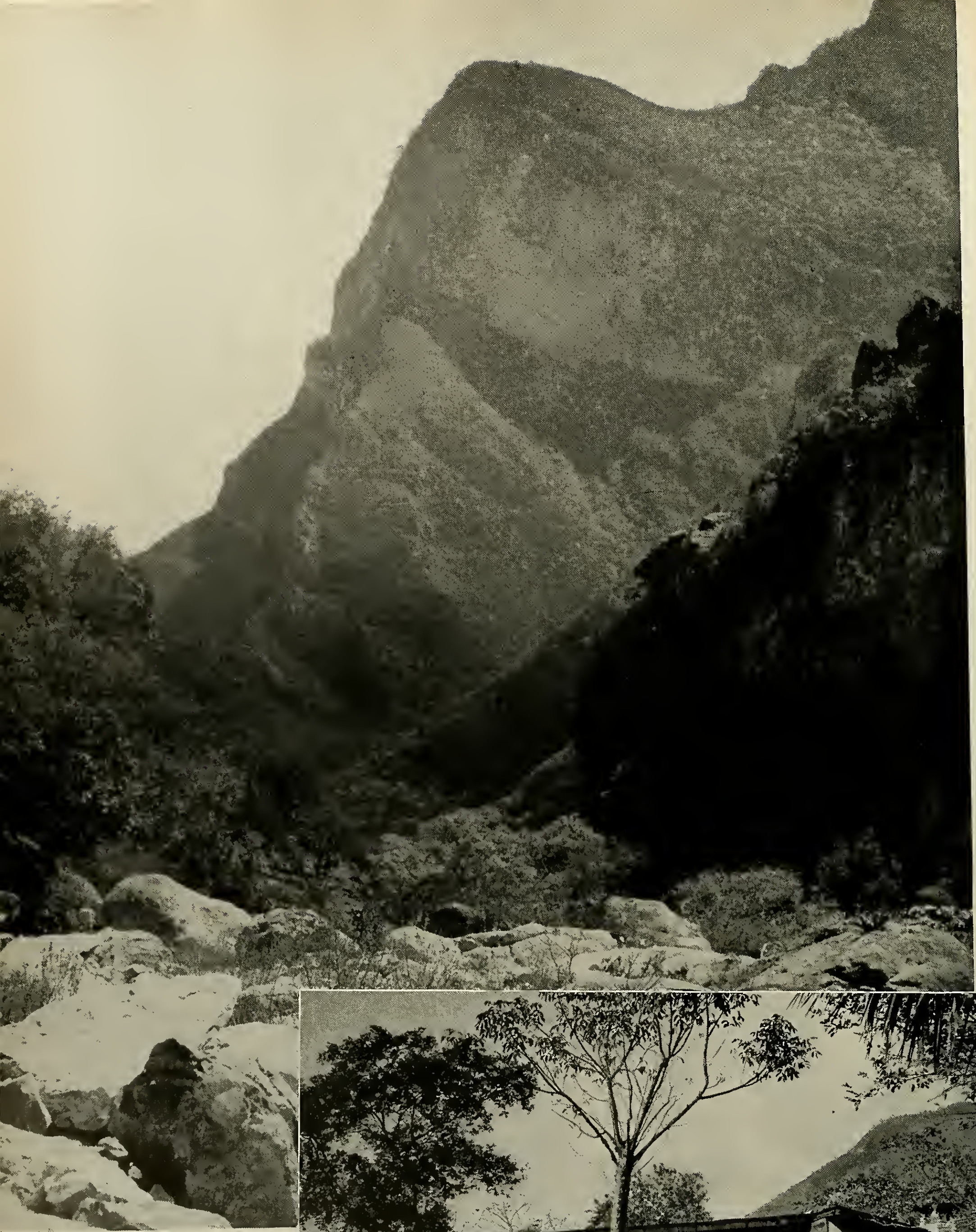
*George Miksch Sutton has traveled extensively in regions far north of the tropical outpost he describes in this article. He has made two expeditions to Labrador and four to Hudson Bay, and is the author of various books and articles. He has also traveled widely in the U. S., Europe, and western Canada. Much of his time has been devoted to the painting of birds from life, and he has illustrated many books. He has taught at the University of Pittsburgh and Cornell University, and he is the president of the Wilson Ornithological Club.

Olin Sewall Pettingill, Jr., who figures prominently in this narrative, is a previous contributor to Natural History. In 1931 he participated with Doctor Sutton in the Carnegie Museum's memorable hunt for the first eggs of the Harris's Sparrow on the shores of Hudson Bay. He has worked with puffins and Arctic Terns in the Bay of Fundy and has also made bird expeditions to the Dakotas, Florida, the swamps of Louisiana, and the lake region of northern Michigan, between various teaching positions. His bird photographs have thrilled many lecture audiences.



▲ A BOLD ESCARPMENT in the rugged country west of the town of Linares, south of Monterrey ➤ THE EXPEDITION'S field headquarters on the Sabinas: a well-screened house of rough timbers on Mr. W. H. Bensel's Rancho tions would disturb me until I returned to learn the answers.

I talked with my friend, Olin Sewall Pettingill, Jr., describing the wonderful birds and telling him of the Rancho. He listened attentively, did some figuring, and proposed that we make it a joint enterprise. He would buy a lot of color-film, have his battery of cameras gone over, bundle his belongings into my car, and off we would go. He would assume responsibility for the photographic program. I would center on paintings in water-color, a collection of bird-skins, and certain environmental studies. As assistants we would have Dwain W. Warner, one of my graduate students at Cornell, and Robert B. Lea, a senior at Carleton. Since we did not have room in the car, they would have to make their way to and from Mexico as best they might.

Four necessary permits were obtained from the Mexican Government. I knew we should also have a first-aid kit with iodine, castor oil, gauze, and the like. But what about amoebic dysentery, malaria, and streptococcus infection? The more I pondered, the more medicine I bought. What I finally took was a great bottle of halazone pills for chlorinating water we could not boil, two quarts of quinine, two very complex and expensive antivenin outfits that we fortunately had no occasion to use, and a bottle of sulfathiazole pills for serious cases of blood poisoning, pneumonia, etc. The car was given a thorough going-over. And for my water-color paintings I ordered 50 sheets of the biggest paper I could get, Strathmore three-ply bond, 22 by 29 inches.

We met the boys in Monterrey on February 25th. Lea had traveled from Minnesota by bus. Warner had hitchhiked from Ithaca. They were so excited they hardly knew what they wanted to see most. We first came to grips with birds at our tourist court. Loud cries sounded from the palmettoes outside, pipings, harsh *chacks,* and noises that sounded like cattle trampling on corn stalks. I could not convince my companions that these sounds were all made by one bird; they had to be shown.

Perched high on a palm leaf, wholly unafraid of us, shining like polished steel but disappointing in shape, sat our Great-tailed Grackle. He gave us an appraising look with his pale yellow eye, then suddenly stuck his bill straight up, puffed out his body feathers, spread his wings and tail, shook as if palsied, and delivered himself of a series of squeals that made every one of us laugh. The squealing became a mere fizzing, and stopped. He wore a quizzical expression, as if half aware of the spectacle he had been making of himself. Then he piped with more ardor than ever, and finally produced from his amazing voice-box the sound of breaking stubble that so often had made me turn to see what creature might be stealing upon me.

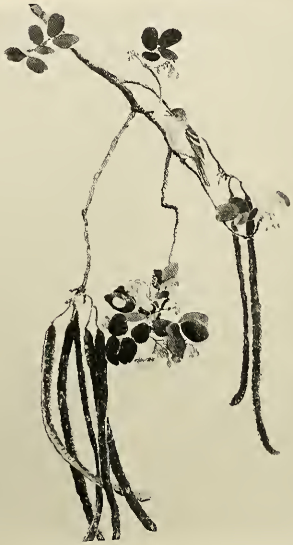
A flock of grackles settled beside him. The males were bent on showing off and clambered to exposed perches. Up went their bills, down went their tails, out swelled their body plumage; their tails spread, their wings waved, and presto! the calliope started. An odd vocal ticking sound was exactly like a child's toy being wound up. They looked as if they were having convulsions, but it was ecstasy. Something seemed to be turning them on and off in twos and

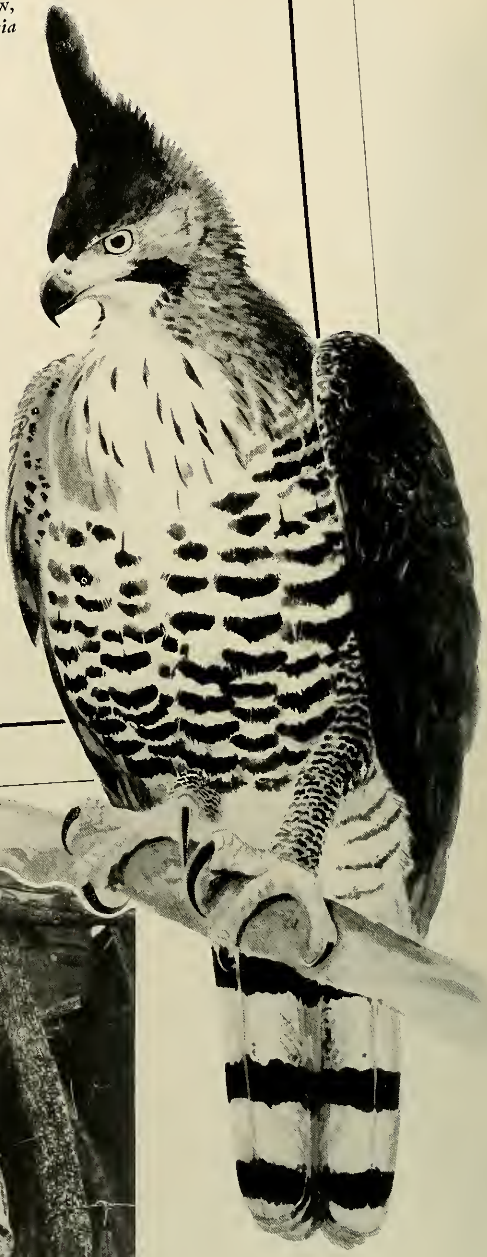
▲ TROUSERS and legs were soon torn when bird life lured the men into the thickets of *huipilla,* or wild pineapple

▲ THE SENORA RODRIGUEZ, who provided the expedition daily with tortillas and carried the wash on a huge platter

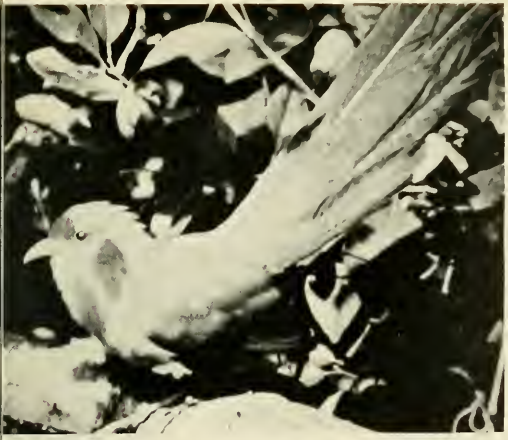
▼ RAMON chopped weeds diligently with a deadly machete

Two bird portraits by George Miksch Sutton are shown below, one a Beardless Flycatcher on a flowering and fruiting *Cassia* branch, the other an austere Ornate Hawk Eagle

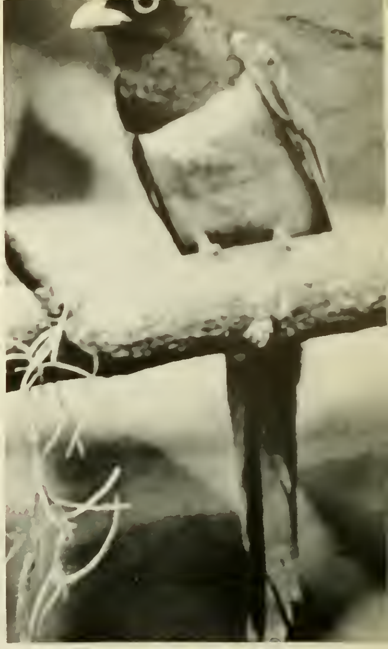




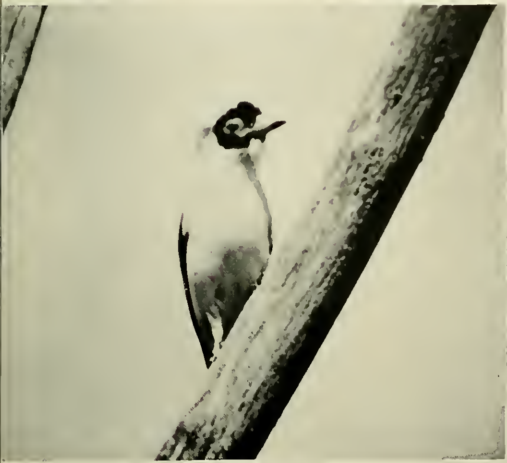
◄ Maclovio Rodriguez, guide, philosopher, and friend to the expedition, with Olin Sewall Pettingill, Jr., and George Miksch Sutton *(right)*



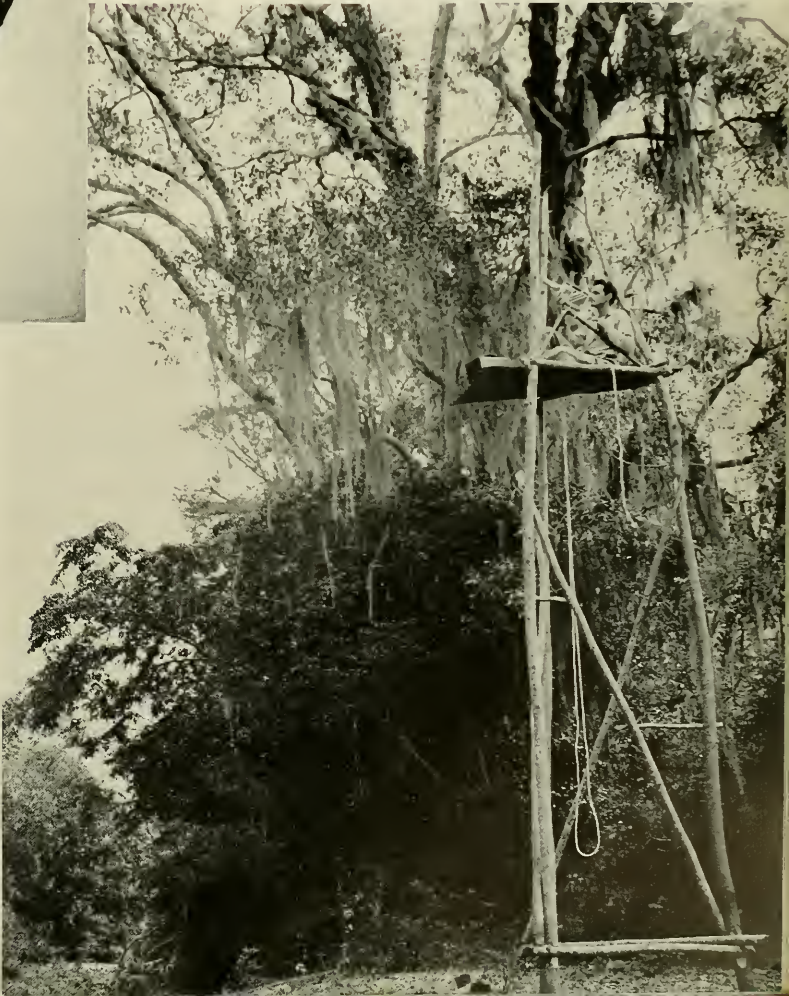
◄ A SQUIRREL CUCKOO caught at close range by the indefatigable camera of Olin Sewall Pettingill, Jr.



➤ BRILLIANT RED marks the breast of the Coppery-Tailed Trogon, which calls, *"cory, cory, cory"* in a husky, plaintive voice



▲ BRANCH AFTER branch of the showy *palo de rosa* withered before the artist could paint the background for a colored portrait of the bird shown here, a Masked Tityra



A 20-FOOT TOWER rose near the half-built nest of a pair of Rose-Throated Becards when the photographer determined to photograph the process, no matter how wobbly his perch threes. There would be a set of shrill *pheeps,* a pause, then more *pheeping* and finally the sound of breaking corn stalks as long as their wind lasted. They worked like a piece of mechanical apparatus, as if someone were pushing buttons or pulling strings. One Great-tailed Grackle is funny enough. Twenty of them going at once are a circus!

A much wanted owl

A bird we were badly in need of was a certain owl. Having been in Monterrey frequently in 1938 and 1939, I knew that in Anahuac Park, a few miles north of the city, we might possibly find one.

In this grove my companions saw their first Green Jays—gay, mischievous, obstreperous creatures that trooped from tree to tree, ostensibly foraging for acorns. They screeched incessantly during the early morning hours, directing much of their scolding at each other. They threatened to steal each other's food, liked to play acorn tag, kept sharp lookout for hawks, and lived in the fond hope of finding an owl. Thus we availed ourselves of their services as guides. In a woodland west of Anahuac Park their chattering announced that some arch enemy had been spied. As I walked forward, the hubbub did not subside. Directly beneath the scolding birds at last, I was pleased to see that they did not fly off. Then I noticed that they were dividing their attention between me and a certain hole in a branch about 30 feet above me. Toward this hole they frequently hopped or flew.

With unaided eye I should never have been able to see it. But when I lifted the binocular, there it was, facing me with eartufts half raised and eyes almost shut—a Screech Owl, the very bird we wanted.

If I shot the owl where it crouched, there was danger it might tumble forward into the hole and I should lose it all together. I called Warner. At the sound of my voice the chatter ceased for an instant, but as Warner answered and approached, the jays became more and more excited. They seemed to sense that we were closing in on the enemy.

Warner began throwing stones, which whirred just past the owl's face and at last struck the cavity itself. Out flew the owl. From somewhere a jay swooped down, screaming at the top of its voice. The owl halted, changed its course, and disappeared as if by magic. Annoyed because I had not shot when I had the chance, I followed. Again jay voices told me where the owl was, for they cried out as long as it was in flight. When it settled, I approached with considerable care. It flew out, and this time making off directly. I aimed and shot it. Without the help of the jays, I would not have got that valuable specimen.

Green Jays have good reasons for not liking owls, but they sometimes mob an innocent creature apparently for pure fun or deviltry. While walking through a catsclaw tangle we chanced to put up a soft-winged night-bird known as Merrill's Pauraque. This is a goatsucker, and goatsuckers and owls had a common ancestor not too many ages back. It looked a good deal like an owl, save that it squatted. We put it up twice, but we wanted especially to see it on the ground. Finally, to our surprise, it circled and returned to settle not far from us in perfect view. With the glass we could study its markings to our hearts' content. It was a beautiful creature—gray-brown, with delicate arrowhead-shaped spots of black on its back and shoulders.

One by one, two by two, the Green Jays stole in from far and near, to rail at this poor creature that never in its life had harmed a jay. They darted at it, scolding violently, but did not alight on the ground near it. The poor pauraque took their insults with dignity, never batting an eye.

During our two busy, drizzly days at Monterrey we listed all the common winter birds and saw one lovely species I had never seen before—the White-tailed Kite. Moving on to Linares, we undertook to make a complete list of the birds, which meant hunting in all sorts of country, by night as well as by day. Here the Brown Jays became our self-appointed vigilantes. Withersoever we walked, they accompanied us, screaming almost incessantly and saving their vilest language for those times when we most wanted quiet. When one flock discovered us, other flocks came flopping comically through the air with their tails bobbing, screaming until our heads rang.

The Brown Jay has one anatomical feature that is, so far as I know, unique. On the chest there is a curious little bag that is inflated with air when the bird screams. It fills or collapses so explosively that the jay seemes to hiccup. The Mexicans call this jay the *Papán,* in imitation of the hiccup.

Rough going

Fifteen miles west of Linares the mountains rise abruptly. A road which follows a tortuous canyon bed for miles and miles leads through these to Galeana. No sooner did Lea and Warner hear of Galeana than they wanted to go there. A wild place was what they wanted—something well off the beaten track. I had been advised not to drive to Galeana, but the more the boys talked the more curious I became. Just how bad was that road?

It was unbelievable. Lea, Warner, and I jammed ourselves into my Plymouth with a young Mexican interpreter named Octavio and climbed the boulder-strewn canyon, across puddles and streams, along the faces of cliffs, through breath-taking defiles. The turns and dips were like jackknife dives. After twenty miles I doubted that we'd make it. At one place we rounded a boulder to find ourselves face to face with the Army. After looking at us boldly the 60 or 70 cavalrymen separated and let us by.

At Galeana, Lea and Warner were introduced to the *Presidente* and extended a welcome. At the little hotel they took a room, which had no rug, chair, nor door-key, but was just the thing their adventurous spirits wanted. Arranging to meet them a week hence in Mante, where they would go by bus, I bade them good-bye and rejoined Pettingill.

He and I proceeded to the Rancho, wondering what was in store for us. Would we find it possible to live there and accomplish the photographic and life history work we wanted to do? And the road to the Rancho—what about that? A hundred yards or so from the highway this road crossed an arroyo, impassable in the rainy season. When did the rainy season begin, and how much rain did it take to make this a raging torrent or a mud hole?

On March 13 we tackled it. The stream-bed itself was firm, the water a mere trickle, but in climbing out I kept too near the edge of the road, and the soft shoulder gave way. For one awful moment I thought we were in for a turning over. As it was, I managed to back straight down the embankment, thus righting the car. But something went wrong with the gas-feeding apparatus, and the half-hour of starting an engine that repeatedly sputtered, whirred, and died, was a soul-trying experience. Finally the engine purred as if nothing had been wrong, and on we went.

Among old friends

At the Rancho we were welcomed by good old Maclovio Rodriguez, Mr. Bensel's tenant, who remembered me and gestured with a smile toward the "red rocks" on the mountain where three years before he and I had hunted curassows. His *Señora* padded forward on bare feet to greet us amiably, and a seven-year-old grandson, Ramón, waited in the offing for the grown-up ceremonies to be completed.

Maclovio set to work with his machete cutting weeds in the doorway. The place had not been in use since we had been there in 1938. The house had a sitting room and bedroom in front, a little kitchen and bathroom behind them, and a store room and porch at the rear. The well-screened windows had swinging shutters, the walls were plaster, and the floor cement.

A thorough cleaning was necessary. Under a table in the store room was a termite's nest as big as a wash tub, a dark brown, shapeless, sinister object. The insects had built their covered runways on the walls, floor, and ceiling. Some of the tubes hung down three or four feet. Mr. Bensel hacked the nest from its moorings, dragged it outdoors, saturated it with kerosene, and set it on fire.

Frisky lizards of several kinds lived in the house, but their faces were so bright and their ways so innocent that we enjoyed having them. We were astonished at the abundance of mice, gray creatures with lambent, dark eyes, big, round, thin ears, and white underparts. They were in the mattress, the bureau drawers, closets, and kitchen. They were exceedingly gentle, and we did not want to kill them, but we knew we could not risk having our bird-skins damaged and that a trapping campaign would be necessary.

We decided to cook for ourselves, thus keeping our household down to four. The *Señora* would, however, prepare a pot of frijoles and a pile of *tortillas* for us daily in the Rodriguez ménage back of our own. Maclovio would bring a supply of water from the river each day, provide stove wood, and assist in building observation blinds.

Pettingill had just given the fourth bureau drawer the scrubbing of its life when two ear-splitting squawks sounded outside. Recognizing them I ran out, shouting to Pettingill to follow. Two Military Macaws, green with golden wing linings, were flying deliberately down river, the sunlight imparting a turquoise shimmer to their pointed wings and long tails. Watching them did us both good.

That first night at the Rancho was astonishingly cold. We were chilly in spite of one heavy and one light blanket; and poor Mr. Bensel must have been miserable stretched out on a bench with only topcoats. An animal, probably an opossum, crunched bones near the house, and our entire mouse population was abroad. They were quiet and gentle-mannered, but I could hear tinkling as they ran about the bed, and once so many of them crowded on a poorly anchored shelf that the whole thing came down with a crash. Lying awake, I was grateful that we had reached the Rancho without serious mishap; that malarial mosquitoes would not prosper in weather such as this.

Next morning Pettingill and I saw immense flocks of Red-crowned Parrots milling about certain tall *ox* (pronounced *osh*) trees near the river. Their flight was rapid, like that of ibises or wild ducks. Often they flew about in pairs, and they did some of their courting in mid-air, screeching and clawing, and fluttering upward as if climbing an invisible wire, facing each other. They were eating the *ox* buds and flowers but losing about nine-tenths, and the sound was like falling rain.

When we approached the parrots, they peered down at us suspiciously with their round orange eyes, making comments about us *sotto voce*. Then, convinced that we were foes, they shot out through the leaves, yelling as if possessed of seven devils.

Three other members of the parrot tribe lived near the Rancho; the not very common Yellow-head (said to be the best talker of them all), and two Sharp-tailed Parakeets—the Green and the Aztec. All the parrots were hard on the crops. Lacking guns, most of the natives were obliged to throw stones or use sling-shots. It was said to be possible to frighten the Red-crowns off by shouting or tossing a pebble or two. But the tough macaws were in no hurry to depart. Squawking hoarsely, they would lean down, deliberately tear loose a whole ear of corn, and fly off with it in their bills.

There were mammals in this country too—armadillos that fared forth at dusk, fearless coati mondis that foraged noisily by broad daylight, White-tailed deer, even jaguars.

The good river

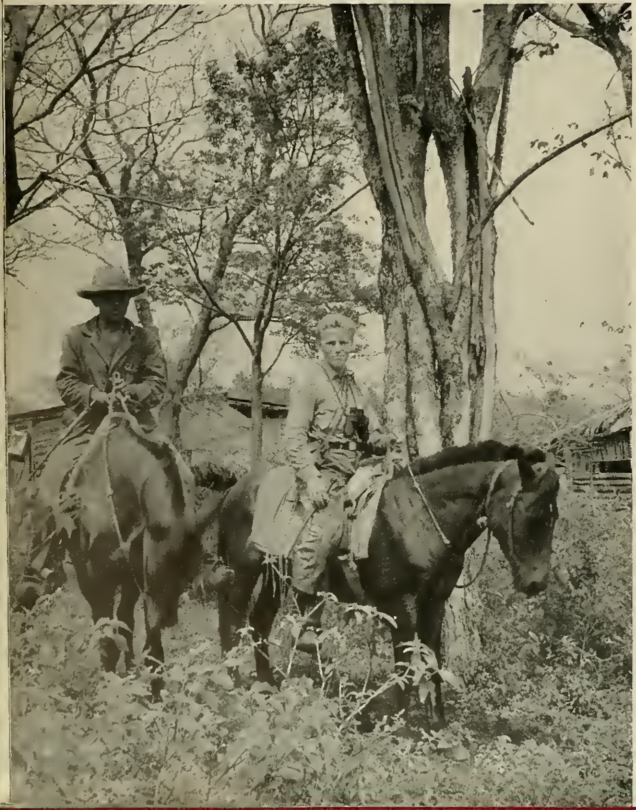
Pettingill and I took our shoes and socks off and waded in the river. Ah, I thought, it's good to be back. The river has not changed. She is friendly and gentle and cool. A wild Muscovy Duck, big as a goose, flapped majestically down stream. On the forest floor beyond the river, the tinamous whistled. Gorgeous black, white, and flame-orange Alta Mira Orioles trooped through the tree-tops. A Coppery-tailed Trogon called *"cory, cory, cory,"* in a husky, plaintive voice that reminded us of a hen turkey's. Off in the distance a Guatemalan Ivory-billed Woodpecker rapped a challenge on a cypress stub. Wherever we went there were butterflies of brilliant colors, and one lovely gray and purple one even followed us about, waiting for a chance to alight upon us.

In mid-morning, along the Gomez Farias trail,

▲ A black vulture, or *zopilote,* on its nest

▲ The most spectacular game bird of the region, the Mexican Curassow, or *Faisano Real.* The expedition discovered a nest of this fine bird during the first few days near the Rio Sabinas

▼ Robert B. Lea, of Carleton College, ready for a side trip



▼ Drinking cool, fresh water from a section of *parra* vine

▲ THE PHOTOGRAPHER and lecturer, Olin Sewall Pettingill, Jr., prepared for action with color film and telephoto lens

➤THE RANCHO'S BUTTERFLIES were as brilliant as its birds. Here is a lemon yellow and black Heliconiid, sipping at a flame-colored blossom

▼ DWAIN W. WARNER, who hitchhiked to get there and didn't miss much after he arrived

we beheld a spectacle that neither of us shall forget as long as we live. A swarm of ants attracted our attention. They were moving out from a point, perhaps their nest, fairly flowing along the narrow runways.

"They must be hunting something," Pettingill suggested. "Or driving something out!"

Indeed, they appeared to be on the war path. Their glistening antennae looked not unlike tiny swords brandished in the air.

Suddenly in their very midst, we spied a four-inch scorpion, moving forward slowly, flicking its poisonous tail in vain. The ants bore down on it in silent fury, biting at every part of its body, literally covering it. Blundering a few steps forward, it lifted its quivering tail, sank, and moved no more.

Toward noon, off in the gray-green tangle between me and the river, I heard the solemn *oomp, oomp* of a courting male *Faisano,* or Mexican Curassow. How vividly I remembered collecting my first specimen of the far-famed bird—when I had not had time or paper to make more than a quick sketch of its tousled head. Now I had both aplenty, and a drawing of this biggest of Tamaulipas birds was part of my plan.

It is impossible to go through a *huipilla* (wild pineapple) thicket silently, but I had to get that *Faisano.* Those nice new pants of mine were torn in a dozen places before I had taken as many steps. And for each snag in my pants there was a corresponding snag in me.

Deep in the thicket, I remembered that no sound of the Mexican wilderness is more ventriloquistic than that of a courting *Faisano.* The *oomp, oomp* throbbed oddly, as if only a few inches from my ears. Then it seemed to come from high on the mountainside, or from the river. It seemed to be under foot!

Suddenly there was a crackling of branches almost overhead as the heavy black and white bird left its perch. Had I known less about the power of my gun, I'd simply have groaned and watched the magnificent bird flap away. But I had hunted some of America's swiftest birds, and the gun came up automatically. There was a fierce roar, and the *Faisano* crashed into the *huipilla.* Pettingill had also been attracted by its booming and heard it fall.

Heedless of the armored thicket, I ran forward. This was an all-important moment for me as a bird artist. The *Faisano's* face would have all the colors of life; in five minutes it would not. What oddly beautiful, recurved feathers were those of that barbaric top-knot! How strange the pattern of black and yellow and grayish ivory on the bill! Lifting my prize, I decided it must weigh eight or ten pounds, perhaps more.

Pettingill's eyes were shining, for he too had been finding things. He had collected a beautiful Brown Woodhewer, a bird he had never before seen alive —not even in a zoo!

In painting my *Faisano* I made a quick pencil outline of the whole bird, then worked out the plumage of the head, color patterns of the face and bill, and scalation of the feet, in great detail. This took several hours—all the daylight I had that afternoon. The paper was damp and not quite flat, the paint was sticky, and my strokes wouldn't dry fast enough. There is nothing so maddening to a water colorist as slowing down to accommodate humidity. In achieving the soft glossiness of the neck I had to put my wash on and then deliberately stand away for five minutes or so to keep from touching some wet spot and ruining the effect.

We were growing a bit anxious about Warner and Lea, for we had not heard from them. The rain might flood the arroyo and cut us off from the highway. By this time we had been bitten in a thousand places by ticks and had to divide our energies between scratching and work.

The next morning was somewhat drier, so I set off for the foot of the mountain to get the part of the tree on which my *Faisano* had been *oomping.* That meant more snags and ticks, but by 10 o'clock the drawing was finished. The bird itself was then skinned and stuffed.

Lea and Warner arrived that afternoon, bursting with tales of Galeana. The whole community had been courteous and co-operative, and they had obtained a good bird collection.

So this was the Rancho! Why, it was a thousand times better than they had dreamed. A sure-enough kitchen, a dining table, kerosene lamps, and screens, —think of it! Walking to the river and back, Lea grew downright hilarious. "Honest to goodness, Doc," he shouted, "It's wonderful here! I'm in glory!"

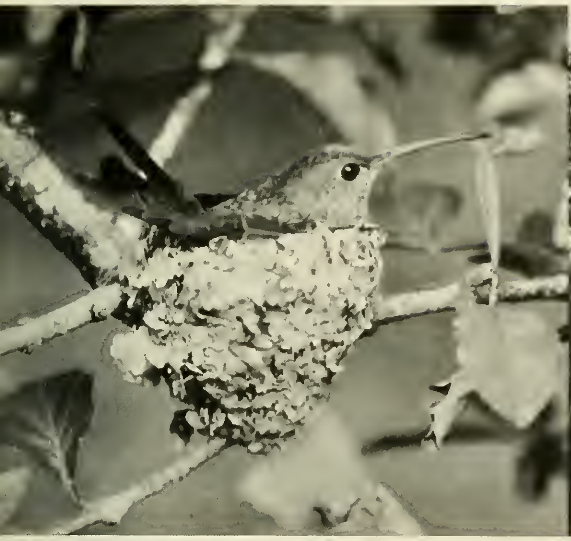
There was much to be done,—nests to find, blinds to build, trails to cut. Maclovio's son, a fine young man named Pepe, bridged the shallows just below the swimming hole with great sections of tree trunk. Maclovio widened all the nearer trails, and even little Ramón helped, chopping weeds with a formidable machete almost as long as himself.

Lea was Pettingill's assistant, Warner mine; and the place bustled with activity. Lines of traps were set for small mammals; lizards were occasionally captured. It was our custom to finish each day's skinning and painting well before dark, write notes after the evening meal, then take a turn with gun and flashlight for night birds.

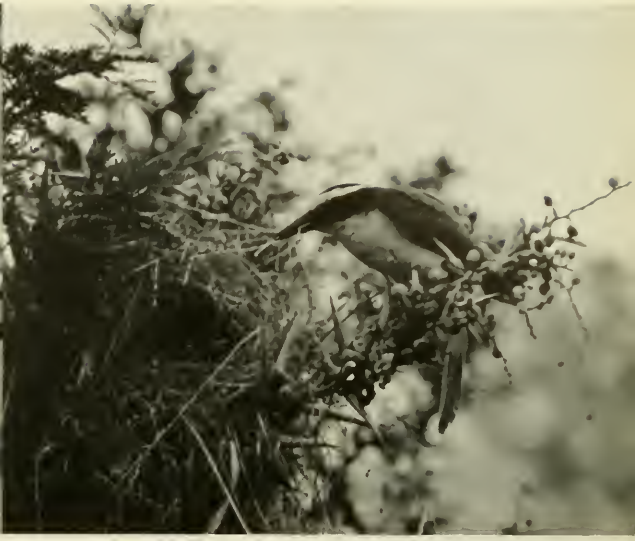
One eerie night, when one of us chanced to open a shutter, we discovered that the house was fairly crawling with scorpions. I saw one on the wall and killed it with a cane. Then I spied an even larger one, clinging to a rafter directly over the bed. By this time everybody was up. We found several more, some of them thin little half-grown ones. From that night on, scorpion hunting was part of retiring.

Bird painting was not all fun. I grew terribly tired of sitting hours at a stretch, intent on recording color and shape accurately. But the series of portraits grew steadily. I was able to paint some of my birds directly from life, but as a rule I hunted in the morning and brought the bird back as quickly as possible in order to paint the bill, feet, and eyes before any color faded.

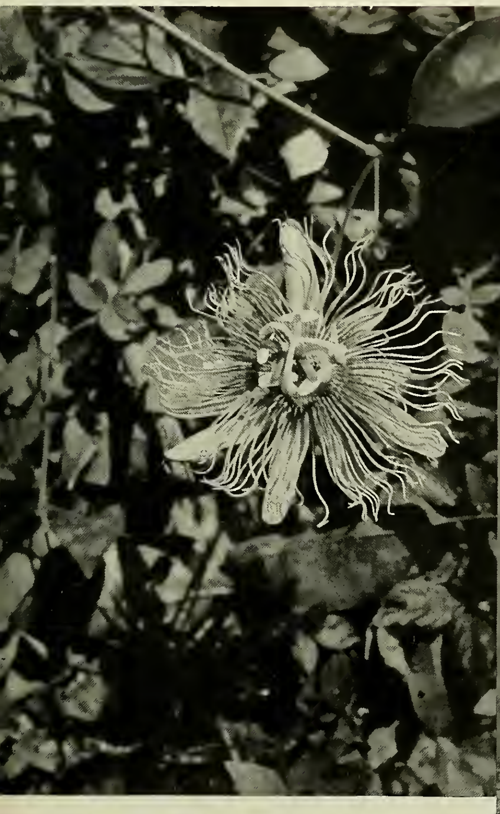
Late one afternoon Bob Lea came in with one of the oddest birds I ever saw. It was a Boat-billed Heron. I was so sick of painting that I would gladly have seen that heron rise up and flap off, but here was a chance that might not come again, so I got a clean sheet of paper and set to work. Darkness fell long before I had completed the picture. But in the



▲ STICKING TO HER GUNS though the camera is only two feet away: a female Buff-bellied Hummingbird on her nest

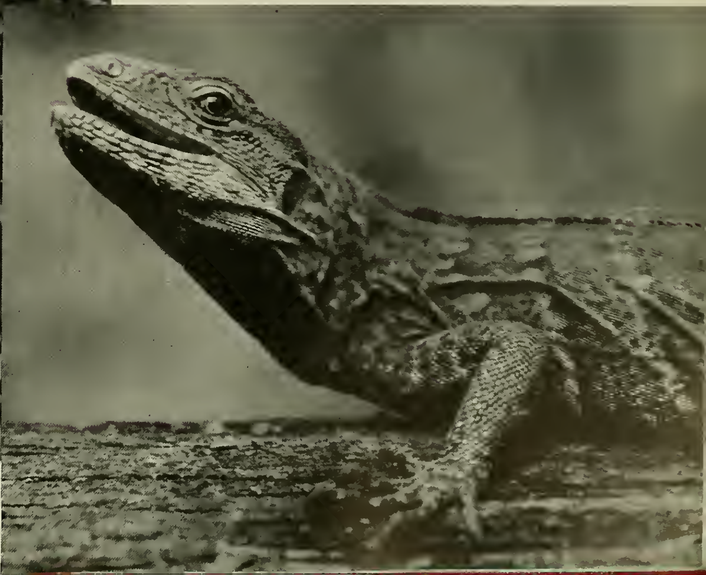


▲ A NOISY AND NOTICEABLE BIRD photographed at its partly built nest: a Texas Derby Flycatcher. Building the nest required 24 days



◀ EXOTIC BLOSSOMS livened the slopes of the mist-drenched mountains with their color and fragrance: a Passion Flower

▼ HIS COUSINS, the dinosaurs, were among the largest creatures that ever lived: a Mexican iguana. Lizards were abundant about the Rancho house



two-hour sketch I put down enough to give a clear idea of the bird's great, round eye and incredible, almost comical, bill.

Branch after branch of the showy flowers of the *palo de rosa* withered before I could paint them in my portrait of the Masked Tityra. Finally, with a pail of water and a rope, we got a branch down and back to the "studio" before the petals wilted.

Each bird took from three to eight hours to paint, not counting trips out and back and hunting time. One bird represented more man-hours than all the others combined, because it was so difficult to find and obtain. This was the Singing Quail, or Long-clawed Quail. On our first day at the Rancho we had heard this quail on the mountain, without knowing what it was. Getting one of these birds became a sort of mania with me. I haunted the rough slopes in all sorts of weather, leaving the Rancho at melodramatically early hours, toiling up the acclivities in fog and rain and sizzling sun, returning sometimes well after dark.

But it was Warner who heard a musical twittering and, peering through the maze of vines, caught a fleeting glimpse of two quail. The "singing birds" were really quail, then; but to what species did they belong?

And it was Pettingill who got the first specimens, a male and female. After 30 days of searching, I would at last be able to paint the Singing Quail!

Pettingill's specimens, shot at close range, were somewhat damaged. Needing one more, I went after it at once. I reached the rocks that the birds frequented and suddenly heard a sharp cry. A single quail shot out from the brush at my feet. I did not fire. Then, not more than a yard from my feet, I saw the bright face of a female quail.

To collect this bird properly I would have to back off ten or twelve paces, or risk trying for it on the fly. I decided to back up. To my surprise, I did not put the bird to flight. At fair distance I shot, securing a perfect specimen. Then I discovered, partly to my sorrow, partly to my great elation, two baby quail that she had been brooding—possibly the first baby Singing Quail ever to be collected by a bird-artist. My painting shows the family together: father, mother, and two babies.

Poor Pettingill had mean weather for his color photography. He tried to be cheerful, chased butterflies, watched birds from his blinds, and wrote voluminous notes; but the photographer in him was sick. When he discovered a beautiful female curassow nesting on her two big white eggs, he sat hour after hour for days, hunched up in his little blind. A color record of these fine birds in action would have been welcomed by zoologists the world over. But the sun did not come out; and one night some unholy varmint ate the eggs. Pettingill came home looking gray—like the weather.

However, we had a fine ten-day stretch early in April and Pettingill was like a spring lamb. There were parrots in the bamboo to photograph, herons fishing for helgramites, doves pumping up milk for their babies, flying macaws, and woodpeckers at work. In the woods could be heard Lea's axe, as a 20-foot tower rose near the half-built nest of a pair of Rose-throated Becards. Pettingill had tried photographing the great globular structure from a high branch, but the whole set-up was dangerous for both camera and photographer. The tower wobbled as Pettingill climbed, but he got the pictures he wanted. These birds nested 50 to 80 feet from the ground; on the other hand, a Hooded Oriole insisted on building her nest inside the green cloth blind, coming and going through the opening used for the lens. Even when he pinned this shut, she would force her way in, dragging the nest material after her.

Out on the highway that led to Mante the weather was almost invariably bright. Looking back toward our camp and mountain, we could see the white, thick cloud that constantly hung there. In it, back among the *jobo* and *ox* trees where the parrots fed, the world was gray, fog-hung, dripping. This cloud resulted from the cooling of warm air that rose from the Sabinas valley. It retained the same shape week after week even during the comparatively rainless part of the year. Moisture in so warm a place meant luxuriant vegetation, and luxuriant vegetation meant birds, hence their abundance and variety and the presence of several species that could live only where such vegetation throve. That was the answer, in its simplest form, to the question that had stirred my curiosity ever since my first visit to the Rancho. Our Rancho country was, in other words, a slender arm of the deep tropics reaching northward along the very base of the Sierra Madre Oriental.

We recorded representative species of four distinctly and exclusively neotropical bird families. These were the Nyctibiidae, or Potoos; the Cyclarhidae, or Pepper Shrikes; the Cochleariidae, or Boat-billed Herons; and the Formicariidae, or Ant Birds. So far as we have been able to learn, not one of these has ever been taken as far north as the Tropic of Cancer.

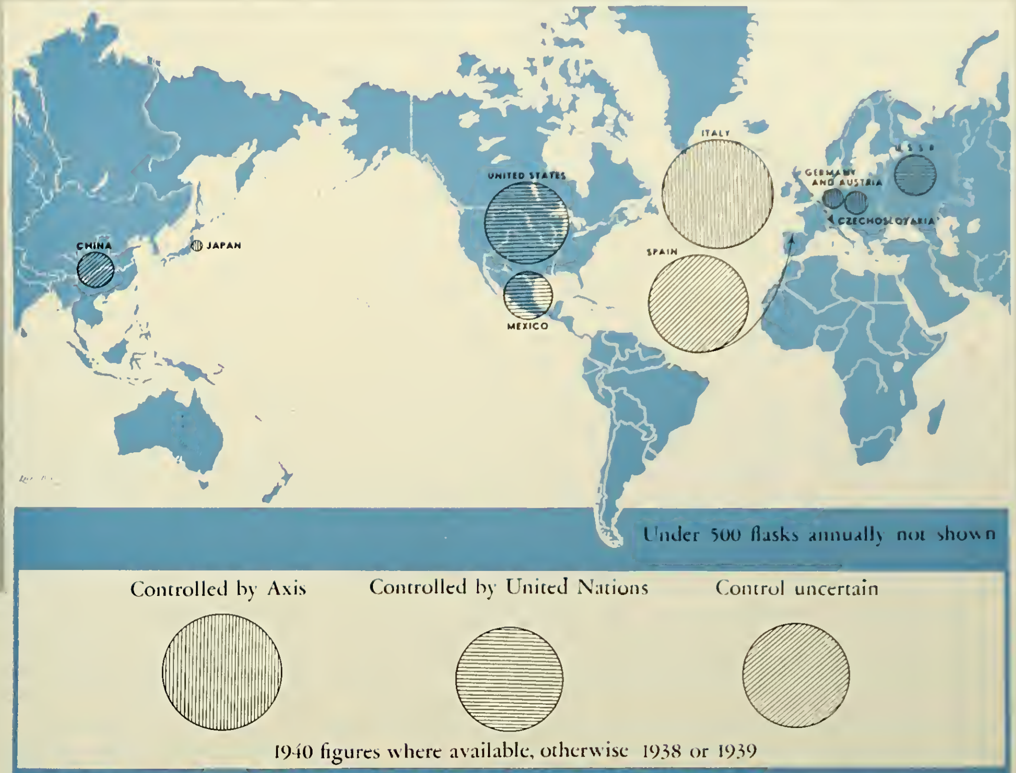
With literally hundreds of birds, lizards, mammals, and insects to be packed, our last few days were something of a nightmare. By this time one of the cameras refused to work; the sights of the combination rifle-shotgun were out of adjustment; and something was wrong with the car's ignition system. On April 26 it started to rain, thunderously. We closed the shutters. The world grew dismally dark. The paths ran water. The river rose. Pepe came to tell us that our bridge had gone. I pictured our poor little car, dragged by oxen, moving ever more slowly across the flooded arroyo, and a last desperate effort to save our specimens even if the car should drift away.

On the third day of the river's steady rising, May 2, we decided to leave as quickly as possible—with chains on the car. The river was good to us. In spite of its bad reputation and our anxiety to the very last, we crossed the arroyo without serious difficulty.

Glancing back across the steaming *huisache* thicket toward our mountain, we bade farewell to the Rancho cloud and the tangled slopes it shielded, where black-spotted yellow orchids, baby Singing Quail, and drowsy Potoos found refuge from the fierce sun. Our lives had for a time been lived there. Treasuring what we had learned of that fascinating world, we would continue to feel a part of it, however far away.

STRATEGIC METALS

NUMBER VIII



1940 figures where available, otherwise 1938 or 1939

Production of MERCURY

Well-known to the ancients as the mysterious "liquid-metal," mercury is a vital ingredient in medicines and bombs—and the Axis has no shortage of it.

By FREDERICK H. POUGH

Chairman and Acting Curator, Geology and Mineralogy, The American Museum of Natural History

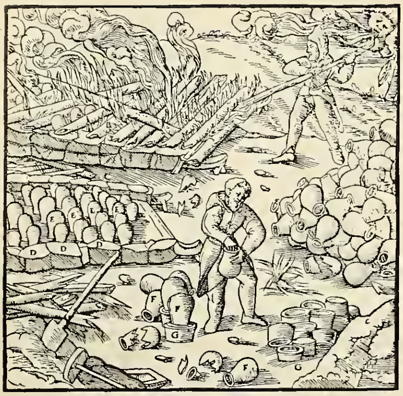
NO metal illustrates more markedly the contrasting situations of different nations as to strategic minerals than mercury. We need have no illusions about an Axis shortage of mercury, for Italy and Spain have long been the world's main producers of this remarkable metal. We, on the other hand, have a real problem in obtaining sufficient mercury for our needs, and when this war is over we may find most of our deposits exhausted.

The popular name for mercury, quicksilver, is the older and can be traced back to the Greeks. The ancients called it *argentum vivum* ("living silver") or *hydrargyrum* ("water silver"), depending upon whether it was found in a native state or purified from the ore. A belief that one type was better than the other continued until recent times in the popular mind. The early miners of California, who recovered gold by amalgamation with mercury, paid a premium for the native mercury on the theory that it functioned more efficiently. The modern name, mercury, is no doubt a result of the medieval custom of assigning a planet to each of the common metals. The planet Mercury, named for the fleet-footed god, was certainly appropriate for quicksilver. The chemical symbol, Hg, however, refers to the ancient name.

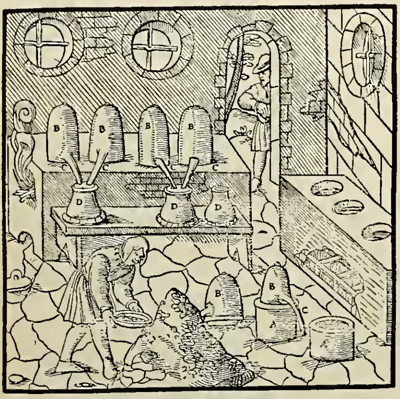
Mercury was doubtless known even in prehistoric times. Its ore was one of the very earliest substances used by primitive peoples, for its brilliant red color would soon attract their attention. Being soft, it readily lends itself to use as a pigment, and the earliest use was probably as rouge or body paint. The Chinese also have records of the use of the metal as early as 210 B. C., while Aristotle speaks of it over 100 years earlier.

Its remarkable appearance as a liquid metal endowed it with mysterious and unique properties, and it naturally re-

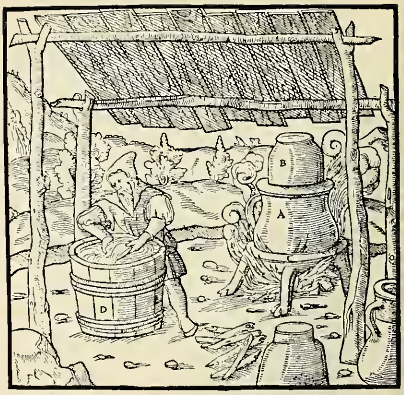
METHODS of distilling mercury in the 15th century are shown at left and right, from Agricola's woodcuts in his *De Re Metallica.* Herbert Hoover's translation of this ancient classic is a notable contribution to the history of mineral science.



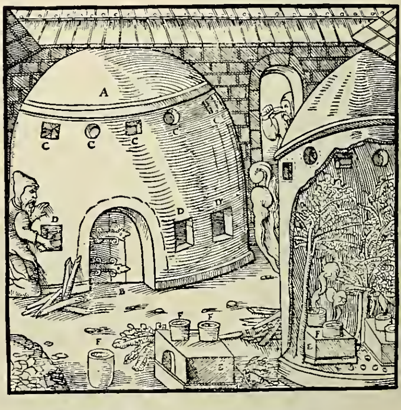
Ore was put in upper of two pots, separated by moss and sealed with clay. Heat distilled Hg into lower pot



In another method, the quicksilver fumes from furnace pots (A) passed through nozzles (C) to condense in the gourd-shaped vessels (D)



Sometimes the ore was covered with sand or ashes. Vapors sought refuge in upper jar; mercury fell into sand



The sloping floor of these condensing chambers collected the droplets which fell from the cool leafy branches put there to assist condensation

ceived the attention of the alchemists of the Middle Ages. One of the best known, Geber (699-756 A.D.), believed that all metals were made of mixtures of sulphur and mercury, and the search for a method of transmuting other metals to gold can no doubt be laid to the wide acceptance of this theory.

There is but one ore of mercury, the sulphide cinnabar. Numerous other mercury minerals are often associated with cinnabar in deposits, and the native metal is commonly found in small drops in cavities, but none is important in quantity. Cinnabar is bright red in color and is one of the most striking minerals for the collection. Usually it forms in solid masses in the rock; crystals are not very common. Lean ore may show thin stringers and splotches of red, while rich ore may be almost pure cinnabar. The rich color of cinnabar makes it a fine coloring agent when it occurs in quartz or opal, and Western collectors often cut and polish small pieces of this cinnabar-impregnated material for gem purposes. Unfortunately pure cinnabar is far too soft for such uses.

Separation of the sulphur from the mercury is now a very simple process, but the earliest method of purification was far more complex. Theophrastus, writing in about 300 B.C., says that quicksilver "... is obtained from native cinnabar, rubbed with vinegar in a brass mortar with a brass pestle." Soon, however, the modern method of heating the ore to oxidize the sulphur and vaporize the mercury was developed, and Agricola (1490-1555) describes five different systems by which this may be accomplished. He cautions repeatedly about the danger of the escape of the mercury vapor and warns that much will be lost if the containers are not carefully sealed.

In all of the early methods, the material was handled in batches. Today the process is continuous. The ore passes through a furnace in a steady stream, and as the mercury vapors rise they pass through a series of cooling pipes. The mercury is drawn off at low places where it has collected and is loaded into standard 76-pound iron flasks, in which it is sold. Further purification can be achieved by redistillation, if necessary. The recovery of mercury is such a relatively simple and inexpensive process that it permits the operation of small deposits and the treatment of the ore in small stills on the spot. The method is in marked contrast to the requirements of some of our other strategic metals, like tungsten and chromium.

Cinnabar and stibnite are common associates in ore veins and in mineralized regions. From this we may infer that mercury ore, like antimony ore, is a mineral which is carried far from the igneous source of the ore body, and we expect to find them in regions which are in their geological youth, where volcanic activity occurred in the not distant past. In this country then, we look again to our West and find that mercury deposits are characteristic of Texas, Nevada, California, and Oregon. Many other states have produced some mercury, and under today's stresses, deposits which could not be worked under the old price of $75.00 a flask become valuable deposits at $199.00.

California has long been the leading producer of mercury in this country. Its mines were worked in the early days of mining in that state to procure mercury for the separation of gold. It was then said that in order to work a gold mine, one must first have a mercury mine. In 1940, California was responsible for 49% of our national production. In that year, nine states and

Alaska produced almost 38,000 flasks; we may be sure that the production today is higher, with high prices offering a new incentive.

That the Italian and Spanish deposits have been dominant for many years—in fact, ever since the days of the Romans—, is implied in the names of some of the California mines. The New Almaden and the New Idria mines are the big California producers, while Spain's Almaden and Italy's Idria are the world's principal producers. In 1938, the last year for which figures are available, the world produced over 140,000 flasks of mercury, of which Italy produced almost half. Spain has been producing approximately half of the remainder, and while little is known of today's yields, we may be sure that they are ample for all Axis needs. In 1940 the United States produced about 38,000 flasks of mercury, and consumed about 10,000 less. At that time it was estimated that the known mines of the country could produce, at $175.00, about a three-year supply.

The uses of mercury are many and varied. It is the only common metal which remains liquid at ordinary temperatures, and does not solidify until cooled to –39°F. It was not until the winter of 1759-60 that Professor Braune of St. Petersburg succeeded in solidifying mercury, and from that date it was accepted as a true metal. Some of its uses depend upon its fluidity at normal temperatures and its expansion and contraction at regular rates, as in thermometers; but the chemical uses, especially the poisonous ones, may be considered more important. Because so many of its compounds are poisonous, mercury is widely used in medicines and drugs. In 1928, one of the few years for which statistics are available, almost 40% went into such compounds.

More of the highly explosive fulminate of mercury (a compound with carbon, nitrogen, and oxygen) was manfactured during the peacetime year of 1928 than in 1917. Fulminate of mercury is easily exploded by impact and is therefore an ingredient in detonators. But because it releases its energy so rapidly that it will not fire a gunpowder charge under normal conditions, it is mixed with a diluent (one constituent of which is the stibnite of which we spoke as an ore of antimony) to slow up its action until the gunpowder can be ignited.

The use of mercury in pigments is important; it makes the vermilion color of paints and inks. The oxide is used in marine paints and is, of course, an important naval use in wartime. Its value lies in its faculty of forming with sea water the poisonous corrosive sublimate, which is fatal to barnacles that might otherwise attach themselves to the hulls of boats. Another compound is used in softening the hairs that are matted together to make felt.

Deep red cinnabar crystals, from a Jugoslavian mine. Crystals like these are rare, however; the ore is usually massive. Its bright color makes cinnabar one of the most striking minerals for the collector

AMNH photo by Bierwert

Certain scientific and electrical instruments require the use of mercury, especially in switches that are made to operate only when they are in the desired position. The mercury closes the circuit when the capsule containing it is tilted; otherwise no current can pass through. The ancient use, the amalgamation with gold and silver, is reassuming importance in the recovery of gold, but this use, like some others, does not result in the loss of much mercury, for almost all is recovered in each distillation. An important use, which will surely now have to wait until the military needs for mercury are less urgent, is in the production of electrical power from turbines driven by mercury vapor in place of steam. Here the same mercury is used over and over again, but large quantities are needed for each installation. Operating at higher temperatures, these turbines give far greater efficiency in fuel utilization and at the same time permit steam to be heated in the same boilers. The mercury vapor, after giving off its power, can also be used to heat more steam, which can in turn generate electrical power. Since the initial mercury investment is high, it is improbable that any new installations will be available to this country until the war is over, but it is a promising new field for mercury in the future.

The American situation with regard to mercury is really very serious. We have prospects of getting larger and larger supplies from Mexico, and perhaps a little from South America, but it is more likely that we shall curtail non-essential uses. Mercury boilers are efficient, it is true, but their discontinuation would release large quantities of mercury for other uses. Felt hats could be eliminated; vermilion is certainly dispensable. Other disinfectants could take the place of mercury compounds; other paints are also anti-fouling. Lead or silver fulminates might possibly take the place of mercury in the field where it is most essential until this war is won, but probably no such stringent measures will be necessary. Meanwhile we are working our deposits to the limit and getting a good supply of mercury, but Uncle Sam had better not get into another war after this one, without a good reserve of mercury safely tucked away for use—unless he has some good "Buck Rogers' disintegrators" to use in place of explosives.

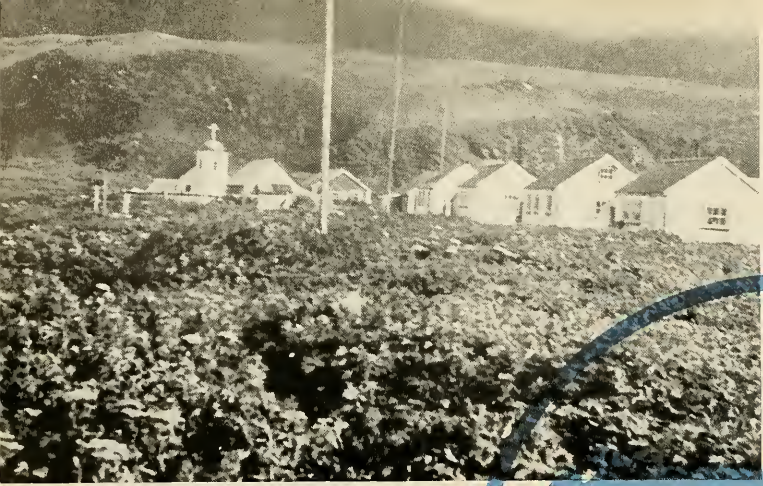
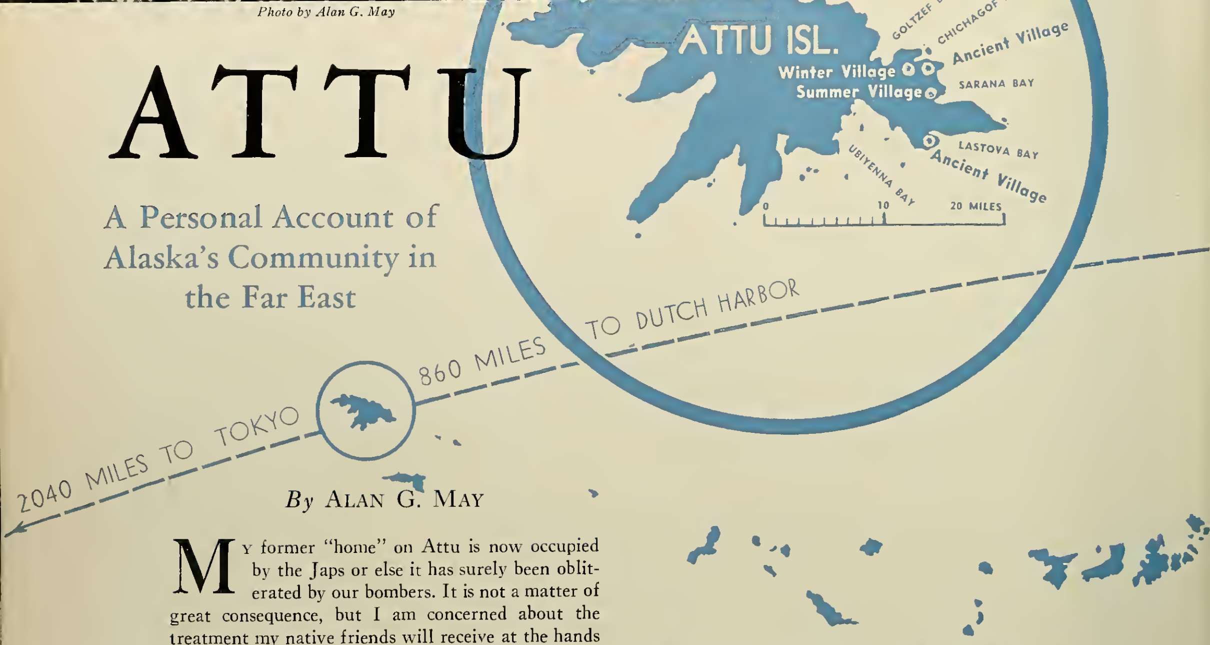


Photo by Alan G. May

◀ THE VILLAGE of Attu, now in Japanese hands, had 43 inhabitants, all Aleuts of mixed blood. The Russian Greek Orthodox church is an excellent building, but there was no resident priest; the village Chief led the services

ATTU

A Personal Account of Alaska's Community in the Far East



By ALAN G. MAY

My former "home" on Attu is now occupied by the Japs or else it has surely been obliterated by our bombers. It is not a matter of great consequence, but I am concerned about the treatment my native friends will receive at the hands of the Jap invaders.

When I arrived in the village of Attu in 1936 the problem of where to live for the duration of my stay was immediately solved by the little Chief who suggested that I move into the schoolhouse. This was by far the largest building on the island and I was astounded to find it contained two schoolrooms, two bedrooms, two kitchens and, strangest of all, a modern bathroom complete with fixtures. One bedroom I found furnished with all the necessities except blankets, and one kitchen was completely furnished even down to crockery and kitchen utensils. I learned later that there had never been a school teacher on the island and that the natives did not want one. Anyway there were only four or five children of school age.

I had come out with a party to make archaeological investigations under the leadership of Dr. Ales Hrdlicka of the Smithsonian Institution, and while he and the others were excavating on Kiska I had been permitted to go on farther west to work on Attu. Here I was left by the United States Coast Guard Cutter "Shoshone," the lone white man on the island. It was possible for our party to reach these inaccessible islands only through the fine co-operation of the United States Coast Guard.

I found that many of the natives knew no English; four or five of them knew an odd word or two. The Chief, however, spoke broken English exceedingly fast—so fast that I found it hard to understand him at first; but later I was able to carry on long conversations with him, and he indeed proved himself a friend in need.

Attu is the most westerly of the rocky, treeless Aleutian Islands and has the distinction of being the only inhabited Alaskan island in the Eastern Hemisphere. It is approximately 30 by 40 miles in size,

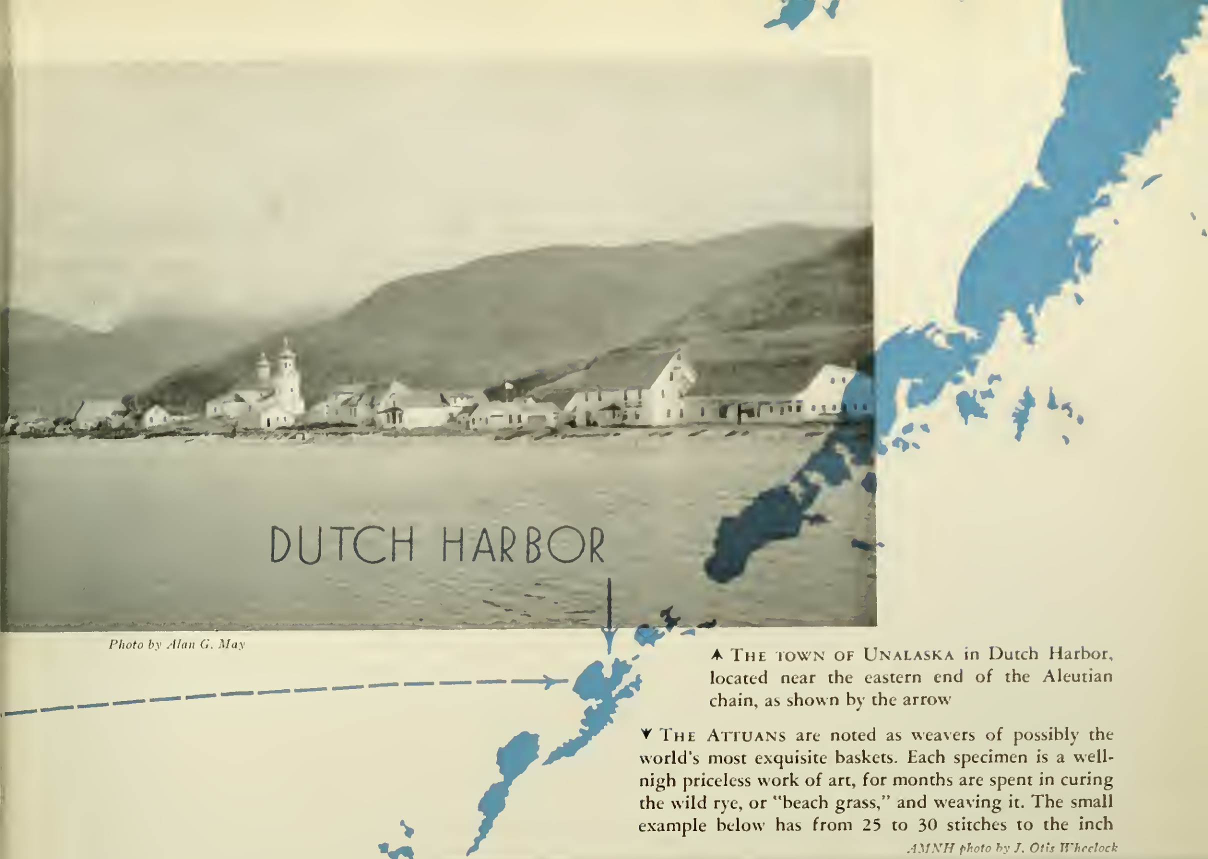


Photo by Alan G. May

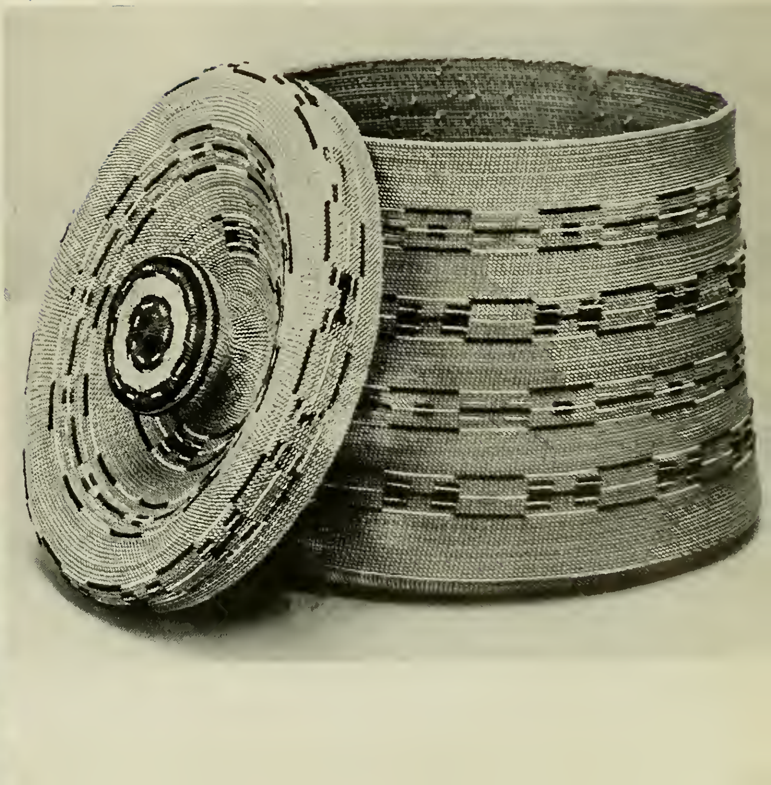
▲ The town of Unalaska in Dutch Harbor, located near the eastern end of the Aleutian chain, as shown by the arrow

▼ The Attuans are noted as weavers of possibly the world's most exquisite baskets. Each specimen is a well-nigh priceless work of art, for months are spent in curing the wild rye, or "beach grass," and weaving it. The small example below has from 25 to 30 stitches to the inch

AMNH photo by J. Otis Wheelock

▼ The chief's wife, working on one of the famous baskets

Photo by Alan G. May



indented by many inlets and bays. The offshore reefs are numerous, and continual fogs envelop the island, making navigation extremely hazardous. Gales are frequent.

One unusual condition exists at Attu that rarely occurs in other parts of the world; fogs are present at the same time that a wind of 40 to 50 miles an hour may be blowing. In spite of such seemingly adverse weather conditions native flowers grow profusely.

A narrow entrance

The only safe anchorage is in Chichagof Harbor, and even this bay has a dangerously narrow entrance, with reefs stretching across one-third of the opening. Here, at the nearest point, a rock could be thrown from the deck to the shore on either side. On several occasions I have passed through this narrow entrance on Coast Guard vessels—once on a cutter more than 325 feet long, the largest ship ever to enter the harbor up to that time. The sight of such a large ship sweeping through this dangerously narrow channel filled me with the greatest admiration for the competence and ability of the officers and men of the United States Coast Guard. The harbor itself has more the appearance of an inland lake, with the village of Attu at the far end.

The inhabitants of this little community of 41 men, women, and children are all Aleuts of mixed blood. It is doubtful if any pure-blooded Aleuts still exist.

One evening, after I had been on the island several days I had my first callers. They were Ivan and Fadc (pronounced Fay-de-say) Hodikoff, both nephews of the Chief. Their combined knowledge of English was about equal to my knowledge of Aleutian, which was exactly six words. I offered them chairs, and there we sat smiling at each other. Nothing happened. I found the situation rather absurd. If we could not converse, then at least we could eat, so I brought out some crackers and made a pot of tea. This consumed, they pulled some archaeological specimens from their pockets and presented them to me,—evidently the object of their visit. In pantomime I thanked them profusely, but still they did not go! When I finally awoke to my obligation and presented each of them with a can of pork and beans they grinned broadly and, jabbering happily, departed almost at once.

The village is in charge of the Chief, who is elected by the natives each year. The present Chief, Michael Gorga Hodikoff, has held his position for the past several years, owing to his successful handling of the affairs of the village. The Chief is assisted by a Second Chief, Agefangel Prokopiof, the tallest man in the village. Both men are capable as well as industrious, and carry on in a most efficient manner.

Several times I had met the Chief's wife, Anastasia, a large, good-natured woman, and she had always smiled or waved without uttering a word, so I presumed she knew no English. One day she came out with Mike to where I was working and, walking up to me she surprised me by saying, "Ullo, my frien'."

Anastasia is one of the two or three women who can still make the famous Attu baskets which are known throughout the world to collectors and museums. This age-old craft is a very slow, tedious procedure and will soon become a lost art. It requires many months to cure the grasses and complete a basket.

The best of the basket makers is Maggie Prokopiof, who is familiarly known to the Coast Guard Service as "Rock of Ages." She does not know how old she is, but in her time she was acknowledged to be the best of the Aleutian dancers. Since dancing seems to have been at one time an important custom, it is surprising to find no musical instruments of any kind on the island except the phonograph. Unfortunately today the real old time dances are almost forgotten, the natives preferring modern dancing.

Maggie, whose name in Aleutian is Wassa, asked me once if I had any children. When I said, "No," she remarked sagely, "Umph, men no good, no good sometimes. Women okay alltime."

Chief Mike and Anastasia called on me one night, and in the course of the conversation I asked Mike if he had heard that King George V of England had died. "No," he said, "Fine ol' man." Then he went out and returned with a colored print of the Czar and his family to show me.

One-man radio station

Mike invited me to hear him broadcast, having been taught by the Coast Guard to use the radiophone. He is naturally proud of this accomplishment, always reporting the weather and anything else of importance that may have happened. Commencing at 8 o'clock each night, Mike starts with, " 'Ello, lo, lo! This KAJU calling KEAW, Umnak, Alaska." This he repeats three or four times. "If you hear this you let me know. This is KAJU, Mike speaking, if you listen you let me have answer okay eight bells." This he says so fast that the first time I heard it I wondered if he was talking Aleutian or English.

Another evening I was invited to Mike's house and found six people there for a tea party. Anastasia served the tea and ship biscuits. It is customary for the natives in their own homes to pour the tea into their saucers, pull the saucer to the edge of the table, and then bend the head down to the saucer to drink. They never did this, however, when they called on me. When smoking, the ashes are dropped on the floor and swept up. Of his wife Mike said, "She all time keep clean house, no do any work." That was the night he showed me the photos of his daughter who died as a young child. These photos showed the daughter ready for burial in her coffin.

No white men live on the island, and although an American has the trading privileges, he pays only a visit of a week or two to the village each year. The trader can supply the natives with all the staples and other necessities they need. When he is away, the Chief takes charge of the store. This store, in many ways, is an asset to the natives, but it also has some disadvantages, for the younger natives are no longer learning the crafts of the older people. Not many years ago the natives all made their own *mukluks* (waterproof skin boots), but today only a few make them, and not many pairs are seen in use. The *kamlaykas* (waterproof coats made from the intestines of the seal) are no longer made. It is easier for the inhabitants to purchase rubber hip boots and slickers, which are no more efficient, than to make them in the old way.

Thirty-five miles east of Attu is the island of Agattu. The natives go back and forth between the two islands in small dories with outboard motors. Why no lives have been lost on these trips is surprising but is probably due to the uncanny accuracy these people show in prognosticating the weather.

Livelihood

The trapping of the Aleutian blue fox during December and January is the only activity from which the Attuans derive any income. Agattu and Attu are trapped in alternate years. The trapping is a community proposition, the number of pelts being divided in proportion to the size of the families and their dependents. It is interesting to note that the church is considered as one unit of the community, and as such receives its pro rata share of the pelts.

Fish, which are caught with seine and gill nets, are also divided among the inhabitants. This community spirit, in the same manner, extends to the killing of sea lions. All sea lions killed are common property; the successful hunter, however, has the first choice of any part of the animal he desires.

Several times the Chief sent me some trout and on one occasion gave me some sea lion meat. He told me to boil the meat for an hour or two, but the smell when cooking nearly drove me from the building. Hot, the meat was very greasy and of a nauseating flavor; but when cold, with the grease skimmed off, it was quite palatable and tender. The cooked meat is almost black and flakes into long, thin strips like leather shoe laces.

The Russian Greek Orthodox church, situated at one end of the village, is an excellent building for such a small community. As there is no resident priest, the Chief leads the church services. Many interesting icons and colored religious pictures decorate the walls. On the doors leading to the sacristy are two old Russian oil paintings, and in the sacristy are many ancient religious books brought from Russia many years ago. In the belfry there is a decorated bronze bell, originally from Russia; but, for some unknown reason, this has been discarded for an American locomotive bell.

The majority of the natives now live in small frame houses, but a few still live in barabaras, the old type semi-subterranean earth houses. The barabaras that now remain in use have been modernized by board walls and floors, stove pipe chimneys, and windows.

These natives are a hard working people and are not often found idle. After the winter months have passed they proceed to the business of catching fish, often going to distant parts of the island and establishing temporary camps for this purpose. They travel many miles in their outboard dories to bring back driftwood for use as fuel in winter. Driftwood is not very plentiful and must be supplemented by coal from the store.

At certain seasons of the year they hunt seals, sea lions, birds, and eggs. Nothing is ever wasted; bent nails from packing cases are carefully saved; the skins, intestines, and stomachs of the sea mammals are used in various ways. Even the sea lion's whiskers are used for tooth picks, and salmon heads are strung up to dry and eventually used for kindling fires.

Years ago sea otters were hunted for their pelts, but as these animals are now protected by both America and Russia they are no longer being killed. The sea otter is still occasionally seen along the shores.

Sometimes the children tame young sea gulls and cormorants as pets, for there are no dogs and cats on the island. After reaching maturity these birds always forage for themselves, but return to their owner's home each evening.

No agricultural products are grown, for the natives state that the growing season is too short. However, vegetables are raised with some success on Bering Island, one of the Komandorskie Islands, 200 miles to the west, so it appears from this statement that the reason is a lack of ambition rather than fact.

Rare contacts with the world

A ship of the United States Biological Survey or of the Bureau of Fisheries may occasionally make a call at the island. These visits and especially those of the Coast Guard Cutters are the high lights of the summer season. When a ship is sighted the Chief immediately raises the Stars and Stripes on the tall flag pole imported especially for this purpose. If the ship is a United States Coast Guard Cutter, Mike dresses in his best clothes—a blue serge business suit with shirt and tie to match—and goes aboard to report on the affairs of the village. He takes with him a list of the persons needing medical or dental aid. When the doctor and the dentist arrive in the village, the Chief sees that all patients are ready and waiting and makes himself definitely useful in many ways to the officers of the cutter.

The United States Coast Guard Service is the mother and the father of natives in the many remote, out-of-the-way villages of Alaska. On these men and their fine ships the natives depend for their meager contacts with the outside world, as well as for their medical and dental care. When a United States Coast Guard Cutter anchors in the bay for the night the whole village is invited aboard to see the movie show. They go out in their dories, all dressed up in their best for this occasion, and although not understanding the movie, they laugh uproariously in the most inappropriate places.

Generally speaking the health of the inhabitants is good, there being only two or three of the older men unable to do their share of the work. One bed-ridden old man, reported to be 104 years old, is conscientiously cared for by Chief Mike in his own home. Mike allows no liquor on the island. This, I think, is one of the reasons why Attu is the best of all the Aleutian villages.

In the past few years the ways of the white man have made considerable inroads into their way of living, but they remain an unspoiled and likeable people.

Their greatest fear was of the Japanese. All the natives of Attu seemed to have this dread and they told a story of some of their men going out in two bidarkas (two-place kayaks) 25 years ago and never returning. Nothing was ever seen of the men or the bidarkas again, and although it would seem that there

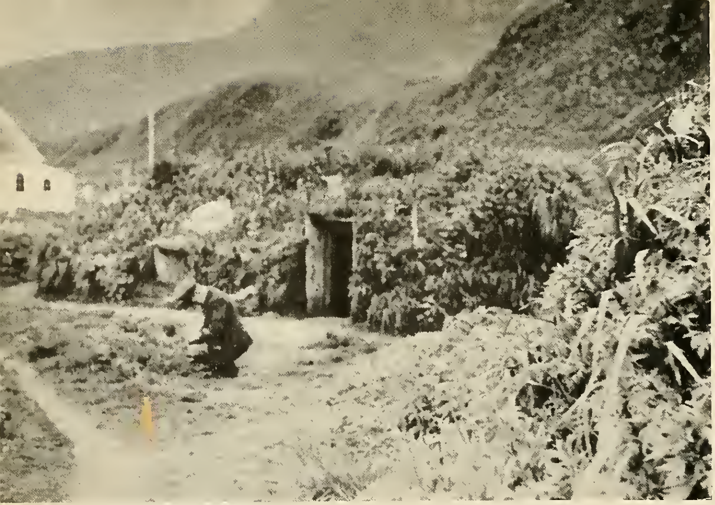


Photo by Alan G. May

▲ THE TRADITIONAL house on Attu is a half-underground *barabara,* covered with sod; but most of the natives now live in small frame houses

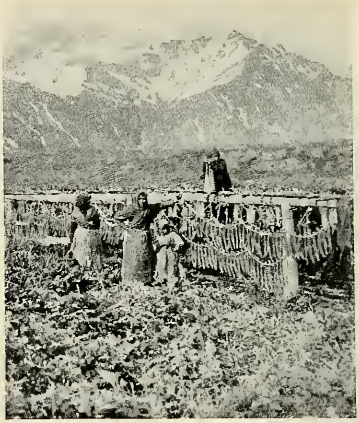


Photo by Waldemar Jochelson

SALMON are dried on racks on the island of Attu and are later stored for winter use

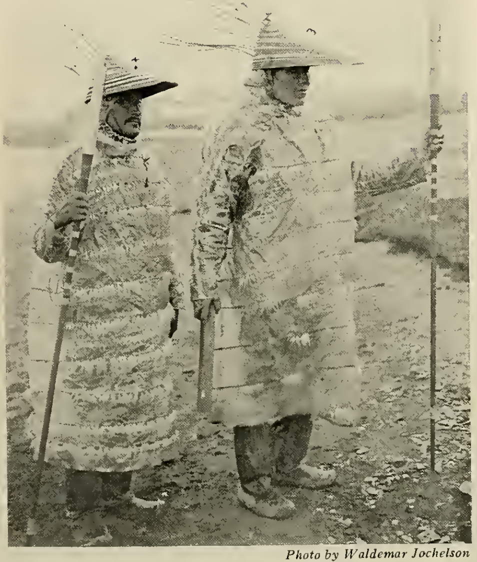


Photo by Waldemar Jochelson

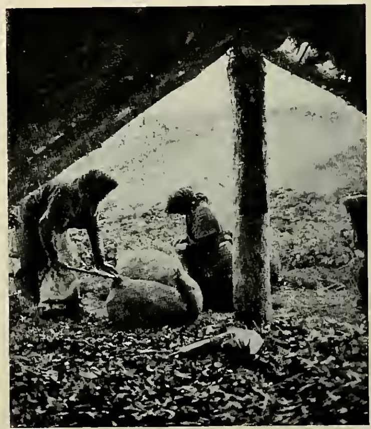


Photo by Waldemar Jochelsan

▲ SEA LION stomachs are cleaned and used as storage receptacles for the dried salmon

▲ ALEUT HUNTERS, dressed for the sea in raincoats made of seal intestines. This garment is serviceable but is no longer made, slickers being more easily procured

Photo by Alan G. May

➤ NATIVE BOYS of the Aleutian Islands. The zipper jacket, like other gadgets of civilization, has been eagerly accepted, but on far-off Attu the natives have remained an unspoiled and likeable people. Even before Pearl Harbor, their greatest fear was of the Japanese might be other explanations for their disappearance, every native on Attu is convinced that they were captured or killed by the Japs.

Farewells

One afternoon I was packing some archaeological material preparatory to my expected departure when I heard someone running, then stumble, and fall on the steps of the building. "An accident," I thought. I found an old native getting up from the steps. He was badly out of breath and only gasped, "Uk—uk!" At first I did not understand, but then he pointed seaward and there was the "Shoshone" just coming in through the entrance of the bay to pick me up after my several weeks on the island.

The "Shoshone" stayed overnight in the harbor and the usual movie show was given for the Attuans. After the show I said a lingering farewell to my Aleut friends on deck, last minute gifts were exchanged, and then they went back to the village—back to the routine of their placid existence.

We left at daybreak for Kiska, and I did not see my friends of Attu again until the following summer. I received several letters from Mike after I returned in 1937, but it has been a long time since the last one came.

When I read of the Jap invasion of Attu I wondered, What did Mike do? Did he run up the American flag when he sighted their ships? Were the natives alone on the island? Did Mike dash to his radio and perhaps, even faster than usual, tell Umnak what was happening? —Or were they too terror-stricken to do anything but hide in the hills? Most of all, I should like to know what has happened to my friends there,—to Mike and Anastasia, to Agefangel, Maggie "Rock of Ages," and the rest. I hope that they are safe but I'm sure that they are not as placid and contented as they were when I knew them.

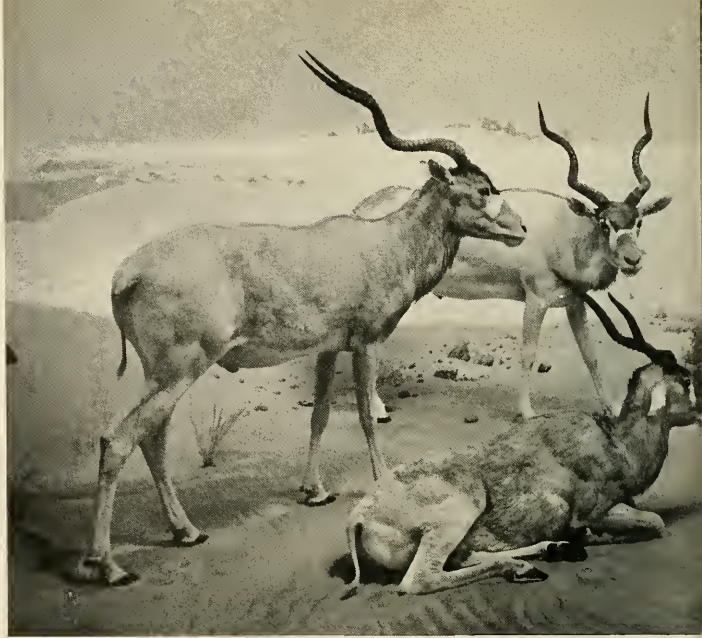
▼ **FLOCKS** of sheep being driven to the top of a hill by high-booted native "cowboys" on Umnak Island in the Aleutian chain

▼ **PILLAR ROCK** is a beacon to Attu's only safe anchorage

Photos by Alan G. May

ALEUTIAN blue foxes *(below)* are comparatively tame on Agattu, often follow one for miles, like a dog

MAGGIE or "Rock of Ages," a well-known character of Attu and one of the best basket makers ▼



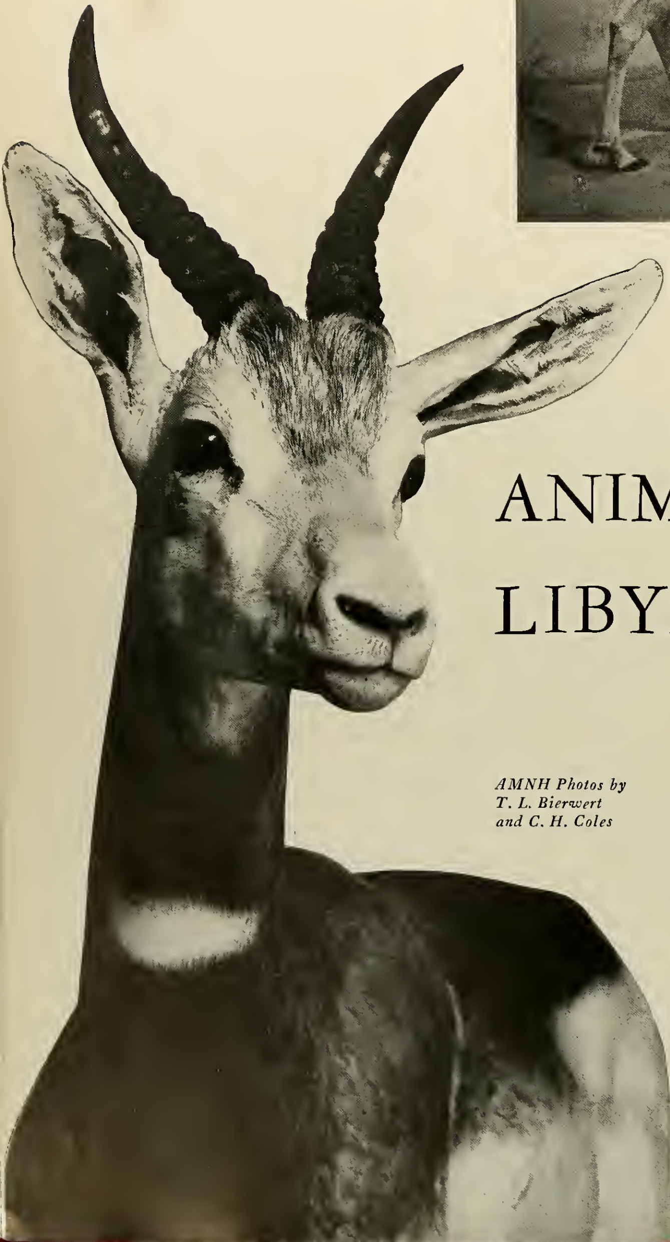
THIS EXHIBIT, which is one of the later additions to Akeley African Hall, is the exact replica of a typical scene in the Libyan Desert and shows some of the animals that are specially adapted to life in its arid, sandy wastes. Both the addax *(left)* and the scimitar oryx *(right background)* have wide, spreading hoofs, efficient for traveling over the yielding sand. For food, all these animals depend on the sparse vegetation of the sand dunes, migrating from place to place in search of pasturage

▲ THE SPIRALLY TWISTED HORNS of the addax *(Addax nasomaculata)* have been known to reach a length of 39½ inches

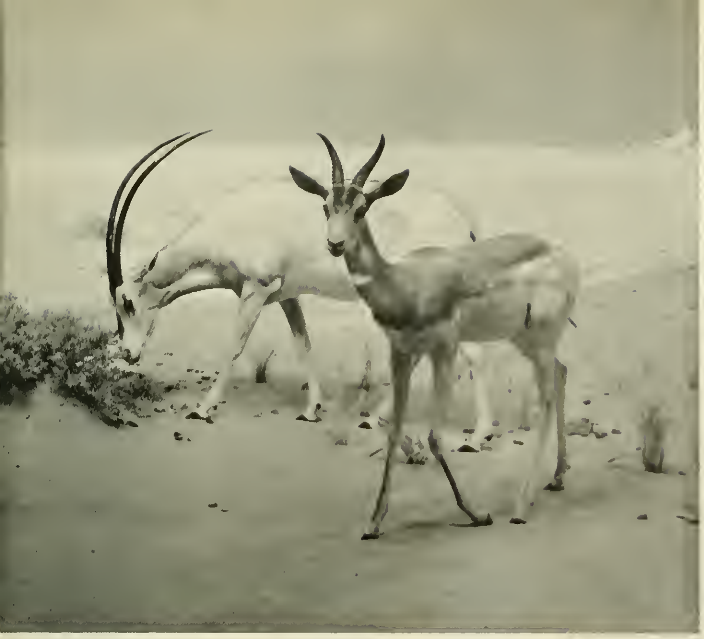
ANIMALS OF THE LIBYAN DESERT

A group portraying the landscape and wild life south of the Egyptian war front, on display in the American Museum

AMNH Photos by T. L. Bierwert and C. H. Coles



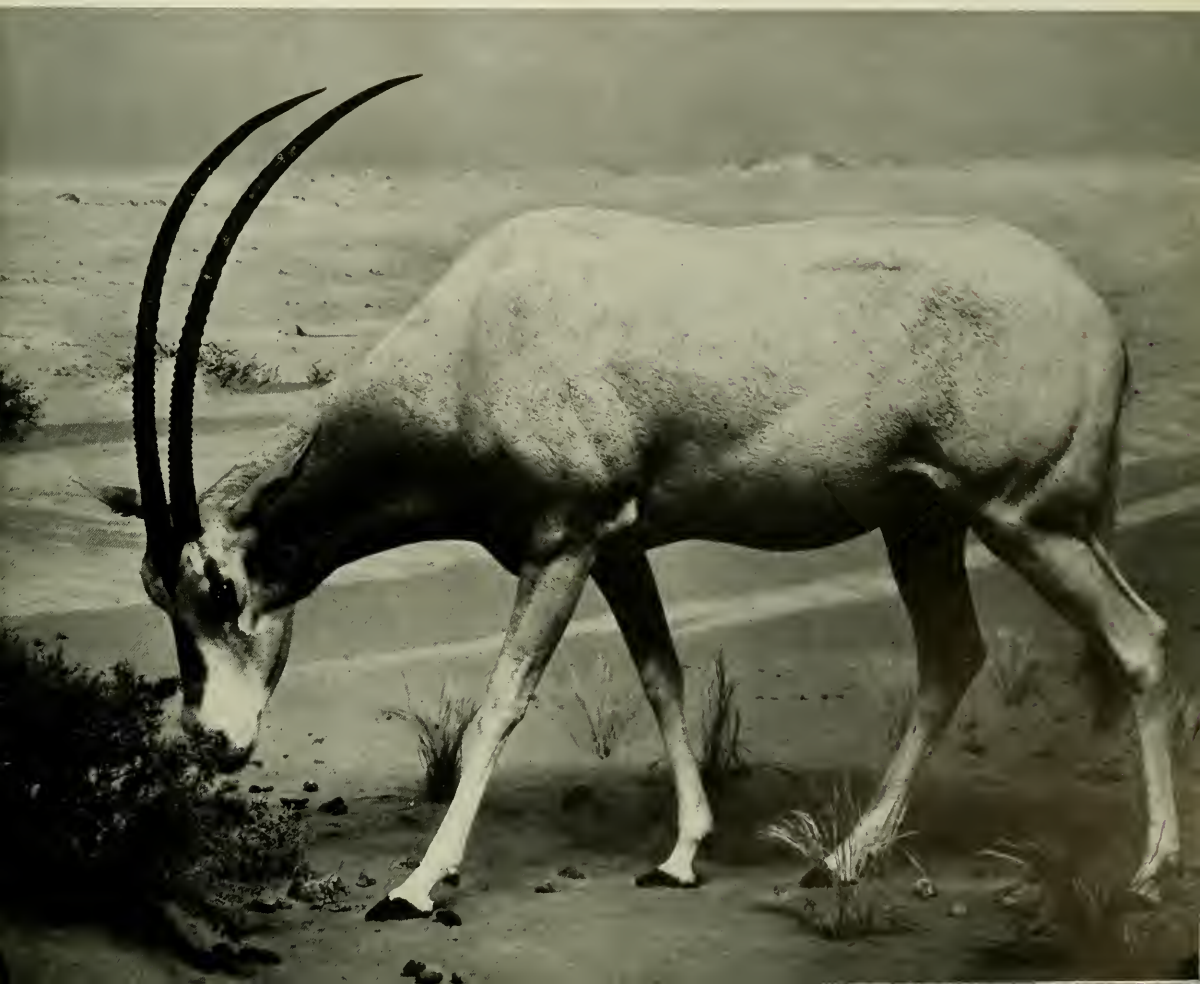
THE GRACEFUL addra *(Gazella dama ruficollis)* is one of the swiftest of the gazelles. Its pale color and reddish marking blend well with the desert landscape, to which it is restricted. When browsing among the shoots of an occasional thorn tree, it often balances itself straight upright on its hind feet. It is one of the largest of the African gazelles, but its tail is only six inches long



▼ THE SCIMITAR ORYX *(Aegoryx agazel)* derives its name from its long, curving horns, and it is also known as the white oryx. It is pale in color and is probably the animal frequently seen as decoration on old bas reliefs and frescoes of ancient Egypt. Its present range is limited to a few sections of the Libyan Desert.

Animals for this group were secured and presented by W. D. Campbell, who described the expedition for securing them in the October, 1938, issue of NATURAL HISTORY Magazine

The group was designed and executed under the direction of James L. Clark, with Robert H. Rockwell mounting the animals and James Perry Wilson painting the background. The foreground and accessories to complete this true-to-life exhibit were executed under the direction of Albert E. Butler



DESIGN for Swimming

By G. Miles Conrad
*Assistant Curator, Comparative Anatomy,
The American Museum of Natural History*

Illustrated by the author

Showing that many of man's "inventions" were discovered by fishes ages ago and that these masters of streamlining bow to the submarine only in the matter of destructiveness

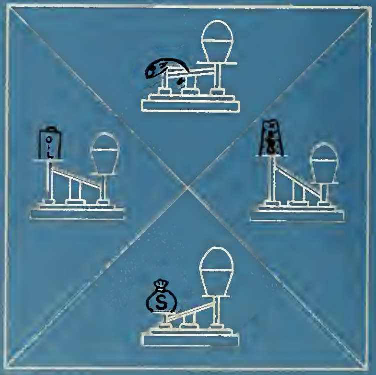
"Like a fish out of water" is proverbial, and its converse is even more true. A fish in water is the epitome of perfect adaptation to environment.

Buoyancy, power, speed, maneuverability — all these and more are the problems that have confronted free-swimming aquatic life in its attempt to overcome space. Of all the classes of animals none have coped with these problems as completely and effectively as the fishes.

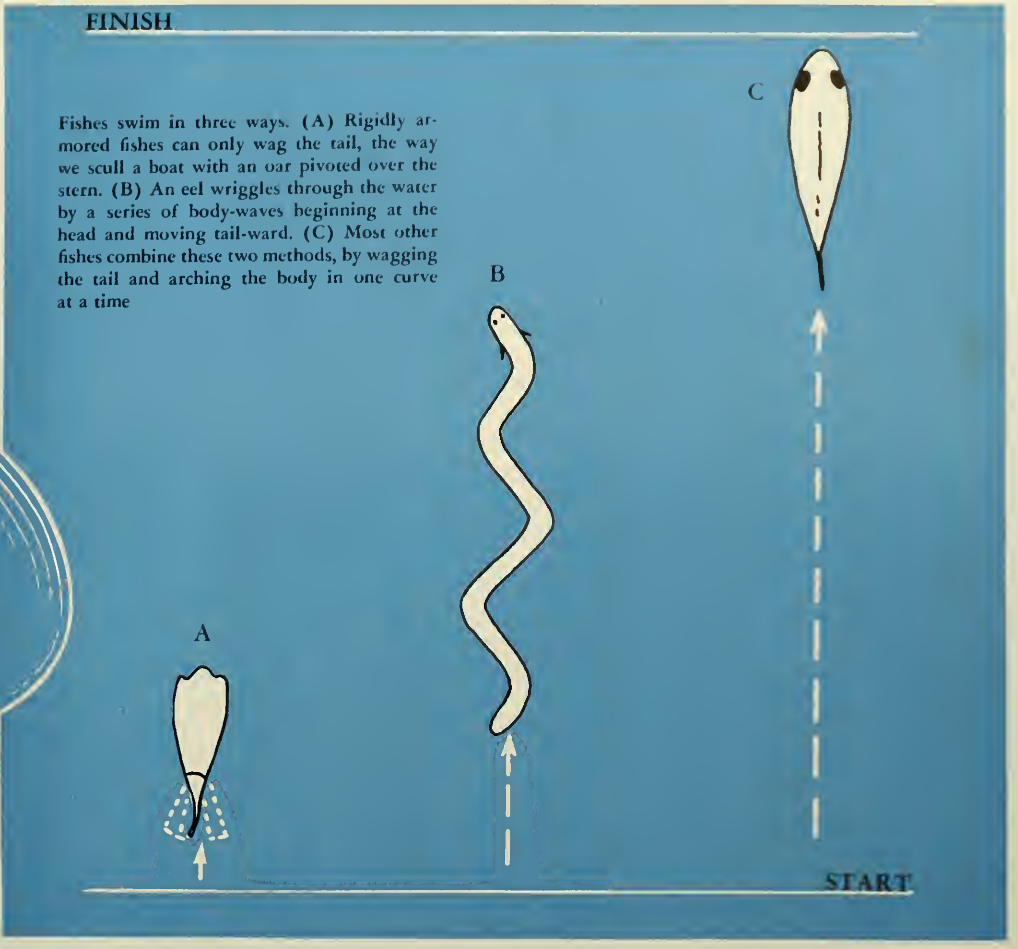
The specific gravity of organic matter (its weight relative to water) is about 1.05. This means that unless the fish devises some means of neutralizing his slightly greater weight he will sink to the bottom. For inshore fishes and most fresh-water fishes this would make little difference, but for the many open-sea fishes sinking would be a calamity. In the great depths of the oceans, pressures as high as seven tons per square inch are encountered, and at the average bottom depth of all the oceans the pressure is almost three tons. The rapid sinking of an object weighing more than water would mean that the fish would be crushed to death long before its internal pressure equalized that of the surrounding water. Even the long-distance soaring birds come to roost easily, but the fishes of the open sea must keep going, must keep combating adverse forces. They wage unceasing battle with the force of gravity.

Fishes and other water-living organisms — even plants—have developed numerous methods for creating and maintaining buoyancy. One dodge that is common among invertebrates is to absorb enough of the surrounding water to reduce their specific gravity and make it approach that of water. Thus the jellyfish keeps afloat with but little hindrance from gravity. For the more intricately organized fishes the absorption of water is not often resorted to, although some fishes lighten themselves by storing away fluids that weigh even less than water.

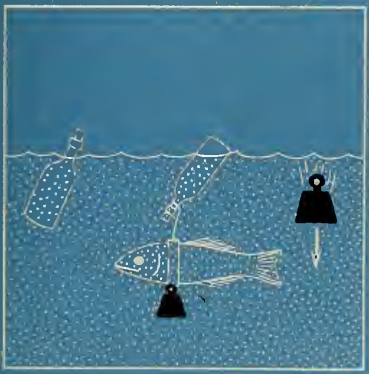
This is exactly what the sharks and many bony fishes have done with eminent success. While flotation is not the primary function of the liver, the fats and oils stored there serve this purpose admirably. Cod, halibut liver oil, and "oleum percomorphum" are all stand-bys of the medicine chest. Oil is poured on troubled waters to quell the waves and is effective largely because it is lighter than water and forms a floating blanket.



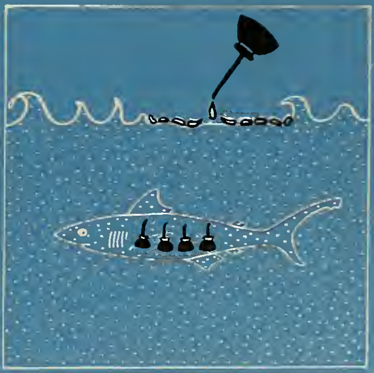
Animal matter is usually heavier than water. If an object weighs more than an equal volume of water, it will sink, even if it is a fish



Fishes swim in three ways. (A) Rigidly armored fishes can only wag the tail, the way we scull a boat with an oar pivoted over the stern. (B) An eel wriggles through the water by a series of body-waves beginning at the head and moving tail-ward. (C) Most other fishes combine these two methods, by wagging the tail and arching the body in one curve at a time



Without buoyancy, a fish would sink to the bottom of the ocean and be crushed to death by the terrific pressure—almost three tons per square inch at average depth



Oil calms the troubled waves because it is lighter than water and blankets the surface. In a fish's tissues it lightens the body and helps prevent sinking

However, the most effective and ingenious device by which fishes regulate their buoyancy is the swim bladder. The methods for increasing buoyancy outlined above all have one undesirable feature—they are inert flotation mechanisms. With the swim bladder, on the other hand, the fish has some control over its buoyancy and may alter its density to meet the requirements. The submarine takes on water ballast in order to dive and then blows it out with compressed air in order to rise. The swim bladder, whose gaseous contents may be increased or decreased, performs the same purpose. In the walls of the swim bladder are bunched masses of capillaries which, it is said, secrete oxygen, nitrogen, and carbon dioxide. Another structure, also in the bladder wall, absorbs these gases. Not only does this device alter the specific gravity of the fish but it also serves to combat the high pressures which the fish encounters in deep dives.

Some fishes, for example the rays, which lack a swim bladder, tend to have a flattened belly. This slows their tendency to sink just as a plate laid flat on the water sinks slowly by side-to-side slipping. Most fish, however, if seen head on are oval or even greatly compressed. Why do these types not sink as rapidly as the above-mentioned dish would if set on edge? It is partly because the swim bladder aids the fish by giving it buoyancy.

Since water is almost the same everywhere, we might think that one body shape would be most efficient for all fishes. If by efficiency we mean optimum speed in a straight line for a certain size of body, we would be correct. However, just as other animals have developed different weapons of defense and offense, so have the fishes. Different methods for killing and swallowing their prey often require modifications of the body-form. Various methods of swimming are of special value to the fish either in the pursuit of food, in escape from enemies seeking him for food, or merely for convenience and minimum waste of energy in his particular habitat.

Dr. C. M. Breder, Director of the New York Aquarium, made an exhaustive study several years ago of the methods by which fishes progress through the water. His work showed that there were three basic types of swimming in fishes.

The first of these has been called *anguilliform,* or eel-like. This method of progression is confined to very long-bodied, snaky fishes such as the eels themselves and the gymnotids, or electric eels, of South America. The second type was called *ostraciiform* after the group name of the rigid boxfishes, or Ostraciidae. The third type of locomotion he called *carangiform,* or in the manner of the pompano or jack. This is the way most fishes swim.

An eel moves forward through the water by a series of undulations which start behind the head and pass along toward the tail. As these movements pass to the rear they encounter, first on one side and then on the other, the resistance of the water. This results in a series of shoves which move the animal forward. The eel goes through the water somewhat in the way a screw goes into a piece of wood except that the eel's motion is flattened out instead of being an actual spiral. But the undulations of his body have to move faster than the resulting straight-forward movement. In other words a great deal more energy is expended by the eel in gaining a fair speed than by the average fish.

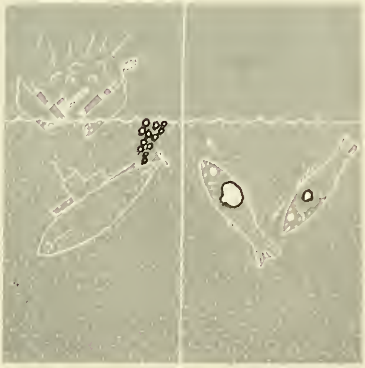
The boxfish and a few of his relatives are encased in an armor that prevents any sinuosity of movement except in the tail. Thus in Breder's ostraciiform movement we are presented with a very close analogy to the sculling of a boat. All of us are familiar with the way in which a rowboat may be propelled forward by one oar pivoted over the stern and pushed from side-to-side. This is exactly what the boxfish does, and it is largely by his tail-wagging, supplemented by his vigorous pectoral paddles, that he moves about.

The pompano method of locomotion, by which the greatest number of familiar fishes swim, is a combination of both the other basic types, for it makes use of the side-to-side motion of the tail plus a certain amount of sinuosity not permitted in the armored fish. Instead of throwing the body into a series of opposing arcs, as the eel does, most fishes arch their bodies into only one curve at a time.

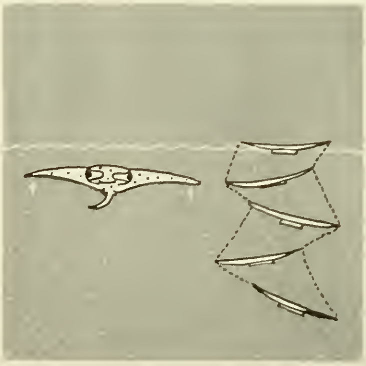
That these movements of the body as a whole are basic in swimming would be a surprise to some of us, accustomed as we are to the swimming of most mammals, in which the extremities act as more or less efficient paddles. Many of us are apt to think that the fins of the fish are the paddles by which the body is moved. Although there are a number of special cases in which the fins of fishes do serve as secondary, or even primary, locomotor organs, they are usually used merely as rudders and stabilizers.

The downward pull of gravity and the action of fins designed to hinder its effect should result in a long, easy-sloping glide. Much of the locomotion of fishes might be described as a series of these glides accompanied by periodic upward recoveries. This is also the way in which an air-glider progresses.

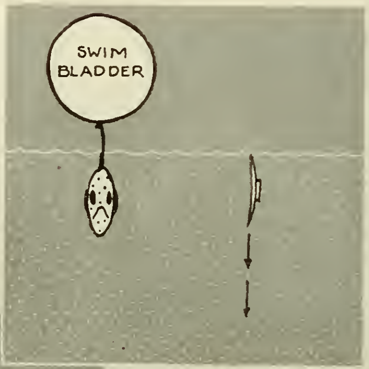
Whence comes the power which is translated into these swimming movements? The very basic unit of the fish's engines is the striped muscle fiber, a small thread-like structure. Numbers of these are bunched together in **W**-shaped units, called myomeres. The myomeres fit one into another along both flanks of



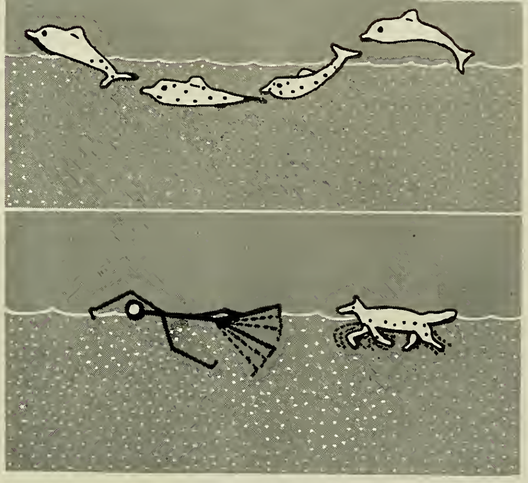
A submarine takes in water to dive, blows it out again to rise. A fish regulates the gas content of its swim bladder for the same purpose



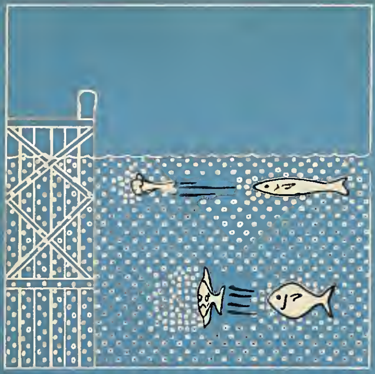
Many fishes lacking a swim bladder are flat like a plate, which sinks slowly by slipping from side to side. The shape helps the fish to stay up with less effort (*above, right*)



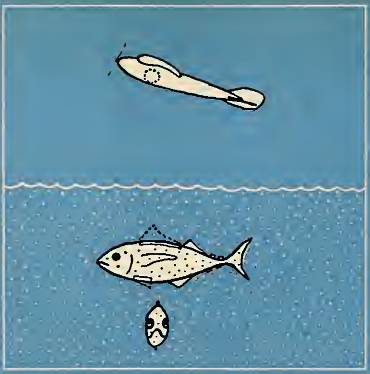
A plate on edge sinks rapidly, and so would a narrow fish except for the swim bladder in its body giving it buoyancy



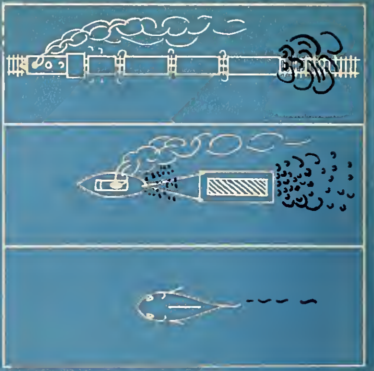
Many suppose that porpoises and fishes work their fins as paddles just because people and four-legged animals swim that way. Fins are chiefly rudders and stabilizers (*left*)



Fishes living in crowded waters, as among coral formations, must be stop-and-go swimmers. These are often broad, so that they can halt abruptly by turning the body sideways



Like a plane that retracts its landing gear in flight, powerful speed swimmers are sometimes equipped to fold their foreward fins into slots, as shown by the dotted lines. The tuna thus becomes a living "teardrop"



Behind a train, whirling dust reveals inefficient streamlining. Similarly, whirlpools behind a square-sterned barge indicate wasted power. Fishes have avoided this fault without exception

the body, and the nerves activating them are arranged in such a way that the contraction of one is followed immediately by that of its neighbor, and so on. Shortly after this wave is initiated on one side of the body a similar wave starts on the opposite side. The result of these waves in an extremely long-bodied fish is eel-like movement; in a shorter one, pompano-like movement; and in a fish where action is confined to the back part of the tail, the sculling action of the boxfish.

In this age of streamlined airplanes, railroad trains, and automobiles we are apt to think of "streamline" as design which permits the utmost in speed. However, streamlining also implies efficiency of performance for the particular task, and low fuel consumption. Thus the best streamlined design for an airplane, which must lift itself into the air, could not be readily adaptable to a train whose superstructure moves through the air while its driving mechannism must contact the rails. The various fishes have different jobs of living to perform. Some are fast swimmers in the wide open ocean and must catch their food by running it down, others live among crowded coral tenements near shore and must be "stop-and-go" swimmers to avoid traffic jams and collisions. Still others are bottom-dwellers, nestling close to or groveling into the bottom.

Speed swimmers

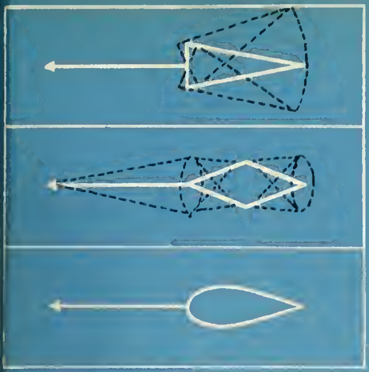
The fast swimmers all make use of pompano-like movements, but not all of them are of the same shape. Many swimmers in the open ocean—like mackerels, bonitos, and tunas—have the characteristic spindle shape, with the area of greatest cross section toward the head end of the body. They are invariably more or less oval in cross section and have a longish body which can deliver powerful side-to-side sweeps. At high speeds all the fins are tucked away close to the body, except for a few rigid stabilizers that prevent the fish from rolling with the tremendous power of the body-sweeps.

On the other hand, among the tortuous and narrow canyons of corals and pilings the fishes are often diamond-shaped in side view. Such a deep body when turned suddenly will very effectively brake the forward momentum developed at even high speeds. Thus the inhabitants of crowded quarters can dart and turn and wheel about with great ease, escaping collision with one another. In the main their food is stationary, and so they have no need for long, fast swims in pursuit of fleet prey.

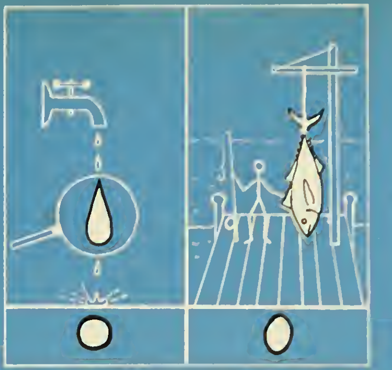
Lurking among the crevices and tunnels are found the morays, unusually lazy eels that are often reluctant to forsake their hideaways even to grab a choice morsel. When forced to desert their dens they of course swim in eel-like fashion.

Perhaps the culmination in speed perfection is the tuna. When the tuna starts a speed run, it folds the prominent fin on its back like a fan into a deep, narrow groove completely out of the way, where it is covered over with two thin flaps of skin. The pectorals must also be gotten out of the way, and along the flanks of the body are two depressions of the proper shape and depth to accommodate them. When the tuna has tucked away all its superfluous bumps, it is a living "teardrop."

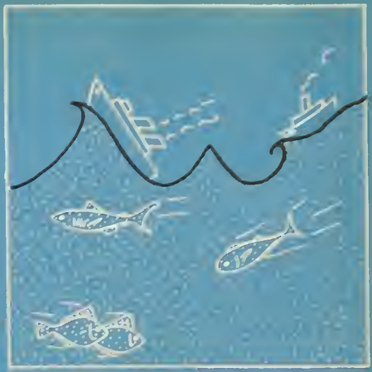
Several years ago, at Wedgeport, Nova Scotia, I had the good fortune to go out on a commercial tuna-fishing boat. In these waters the tuna are harpooned from rather small gasoline-driven cruisers. After an hour's maneuvering we luckily spied a tuna, and our harpooner promptly stuck it. Now in the swordfishery, farther north, when a swordfish is harpooned a keg is thrown overboard to which the line is attached, and the fish is allowed to tow the keg hither and yon until thoroughly tired. But when we tied into our tuna the line was fastened to a dory! The dory was thrown overboard. Ours was a rather slow boat making perhaps seven or eight miles an hour, but when we tried to catch up with the dory, I was astonished to find it slowly pulling away from us. The tuna was dragging a goodly length of line and a dory at about ten miles an hour. The rope was slanting to great depth. In 30 minutes or so the fish had sufficiently tired so that we were able to approach and capture it —but not without a fight! Other fishes have such



A square bow is obviously inefficient and encourages wobbling. Nor is a sharply pointed bow much better. A curved bow is best, with greatest cross section forward of the middle



A drop of water from a faucet assumes the ideal shape. Its rounded front and tapering tail are commonly regarded as the perfect embodiment of streamlining. Tunas are similar, but oval in cross section



Because a boat travels through both air and water, it cannot be compared with a fish. The naval architect, unlike a fish, must fashion his ship so its bow will rise with the wave

strength, for example the manta, but it is doubtful if they have the speed.

Work has been done in recent years on the principles of engineering involved in the streamlining of a fish. It must be pointed out first that regardless of the density of the medium through which an object must pass, the basic rules of streamlining remain the same. Thus a form which moves efficiently through air will move equally efficiently through water, or even through oil for that matter. Why then are submarines so slow when compared with airplanes? There are several reasons but the main one is the obvious one that the denser medium offers more resistance.

Eddy currents

Therefore knowing that the dynamic properties of gases and liquids follow the same laws, we may examine the efficiency of some of man's efforts compared with those of the fishes. If you have ever stood on the rear platform of a train chatting with the brakeman you must have noticed the great swirl of dirt and paper which follows like a tail. The air vortices and eddies which are creating this disturbance are caused by air which has been displaced by the train in moving forward, rushing to fill the partial vacuum at the rear platform. For the same reason a boat with a square stern leaves a wake full of whirlpools and eddies, which tend to hold the boat back. This is one faulty element of design which fishes have without exception avoided.

At first thought it seems that a sharply pointed front end is all that is necessary for an object to cleave more easily through the air or water. But this is not the case. A sharp point, strange as it may seem, is not as efficient as a dull one. And besides this, there is the crucial question of the curve of the sides of the body—especially the location of its greatest cross section or bulge.

Common sense, backed by experimental trials, tells us that an object which presents a flat surface to the direction in which it is moving is bound to be inefficient. The towing of a scow is a slow and laborious job, even if it carries no great load. Furthermore, experiment shows that if a perfect spindle shape has its greatest cross section at the middle, it is not much more efficient than the scow-shaped object. Somewhere between these two is the best shape for a "high-speed" streamline. That is, the greatest cross section of the body must be somewhere between the middle and the front end.

The cross section of the wing of an airplane is frequently used as an example of streamline, but this is not too good an example, for one of the functions of the wing is to lift the plane. A better analogy may be found in the fuselage or body. Best example of all, however, is the familiar teardrop shape—the shape of a drop of water dripping from the kitchen faucet. In order to respond as quickly and as efficiently as possible to the attraction of gravity the drop assumes what is commonly considered to be the perfect embodiment of the streamline. We see that it has a rather blunt front end—not pointed, not flat—with the greatest cross section well forward, and with a tail which tapers sharply to a point; a description, incidentally, which cannot be improved upon for the general body-form of the tuna. However, the fish and the teardrop differ in the shapes of their cross sections. The drop is circular, and the fish oval.

Fishes differ from surface craft

The greatest difficulty in comparing man-made objects, such as submarines or airplanes, with fishes is that fish are flexible. In fact their very movement depends, as we have seen, upon the sinuosity of their bodies. It is only when the fish is coasting or gliding along under momentum attained by violent muscular effort that we can compare it with a submarine. If we try to compare a fish with a surface boat we run up against the difficulty that the boat travels simultaneously through water and air, which have markedly different densities. For example, the naval architect is much concerned with the "lift" of a vessel, or the ability of a ship to raise its bow with the wave so it will not be buried in the water. This problem is unheard of among the fishes.

The exact position for the cross section of greatest area apparently varies in fishes in accordance with different life habits and with size.

Because the fish is subjecting his body to violent whip-like sweeps in his forward progression, he must devise some mechanism to keep him from rolling and prevent tipping over. The tail fin aids him in this, with its upper and lower lobes, which are quite rigid in some fishes. In the case of most speed swimmers there are a number of dorsal and anal finlets which are nondepressible and one or more fleshy tabs jutting out at the narrowest part of the trunk region. These act as stabilizers somewhat as do the feathers on an arrow, or the bilge keels of a ship.

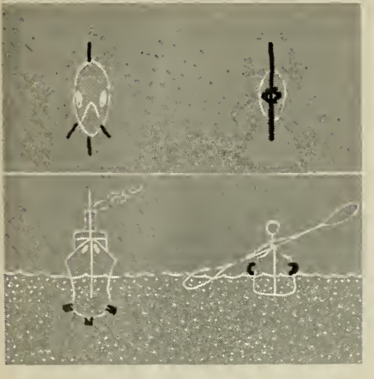
The distance from the forward end of the fish to the plane of greatest cross section is termed the "entering-angle." The remaining distance from this plane to the hind end of the body is called the "run." The relative lengths of these items vary from species to species and may serve as an indication of locomotor habits. The high-speed fishes have a relatively short entering-angle and a moderately long run. Fast but quick turning darters are apt to have these two measurements more nearly equal.

One of the drags on a body moving through a gaseous or liquid medium is caused by "skin friction," which is probably a surface tension phenomenon. In an effort to cut down this skin friction the hulls of boats have been kept as smooth as possible, and at one time it was popular to grease the hull to make it slip through the water smoothly. A vessel has actually been designed whereby this skin friction is cut to a minimum by jets of water released along the flanks at about the plane of greatest cross section. These jets form a sort of lubricating coat over which the water already displaced by the entering-angle can flow quickly and smoothly.

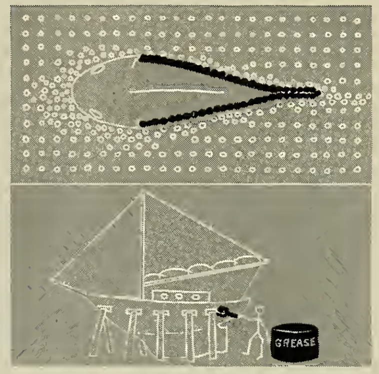
Having learned that such a device actually increased the efficiency of movement, it was easy to turn to the fishes and see that this was exactly what they had been doing for over 100 million years. Water taken in at the mouth for purposes of breathing is expelled through the gill slits, which are usually placed near the plane of greatest cross section—the theoretical optimum position for such jets. The flanks of the fish are thus coated not only with the usual mucous but also with a very thin glaze of water which remains relatively stationary while the water displaced by the entering-angle rushes by to fill the potential void behind the fish. If the run tapers sharply, the displaced water is returned with the least possible turbulence. So important is the squeezing effect of the returning water as it closes in on the run that it tends to push the fish forward. This action has been described by some as the same effect by which an orange seed may be shot out from between thumb and forefinger.

Even some fishes that lead sedentary lives have to be streamlined, in order to keep from being swept away in a rapid stream. The same principles of streamlining apply, of course, whether it is the fish or the water that is moving. Thus brook trout can face up a fast-flowing stream and maintain their relative position merely by lazy, easy back-paddling of their fins. So streamlined are they that the stream flows around them with little pushing effect. There are others living in swift flowing rivers which characteristically hug the bottom. In such forms the upper surface usually presents an efficiently streamlined shape to the moving stream.

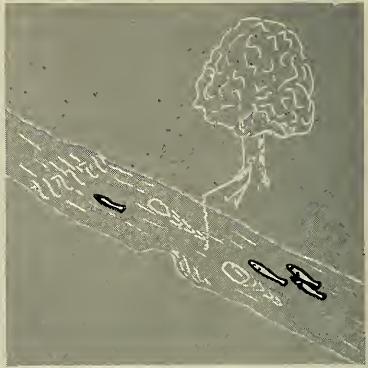
There remains much more experimental work to be done in the study of fish streamlining. So far, wind-tunnel and towing-tank tests have been confined to rigid bodies, not the flexible dynamic machine that is a fish—a machine that finds its fuel as it travels and bows before the submarine only in the matter of destructiveness.



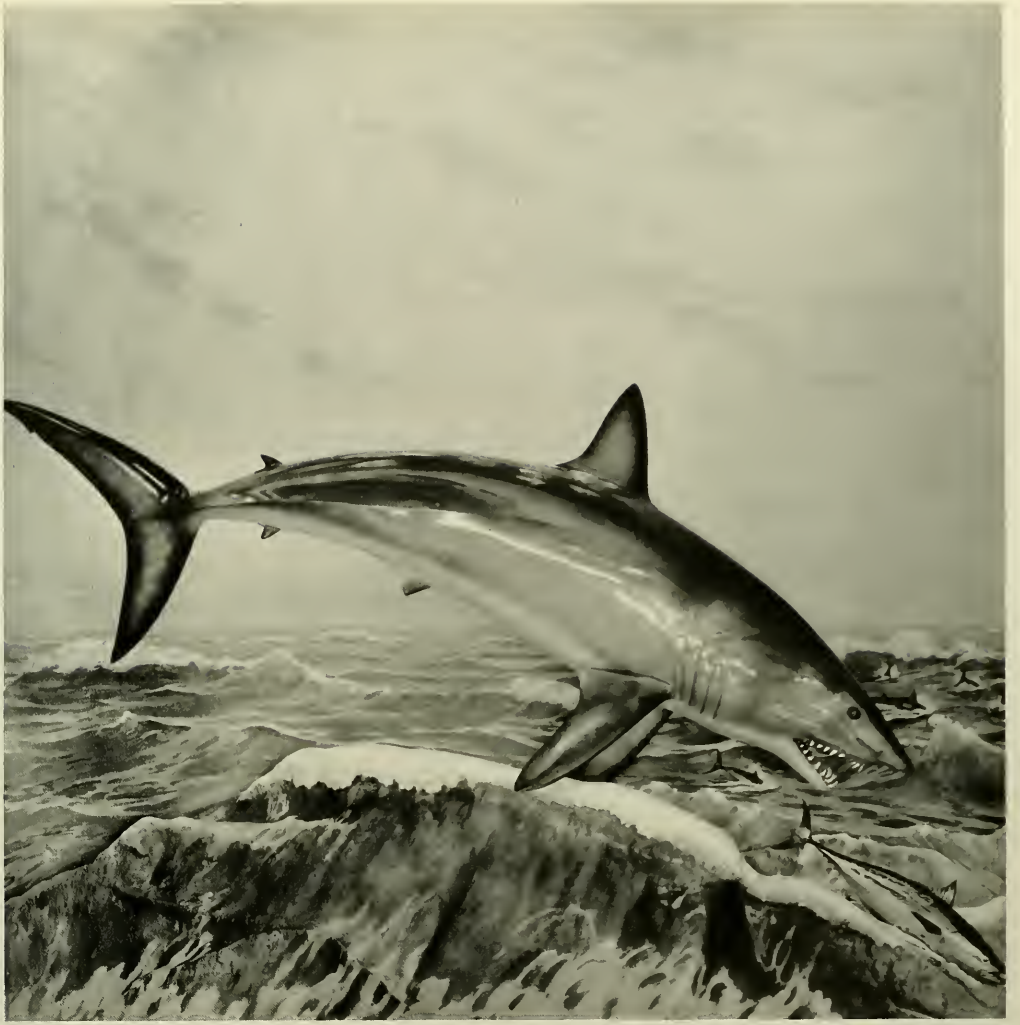
A fish propelling itself powerfully forward could not keep on steady keel without fins. Bilge keels on a ship and "blisters" on a sponson canoe serve the same purpose



It was once popular to grease the hull of a ship to make it faster. Fish have been "lubricating" their sides with a stream of water from the gills for 100 million years



Even if not great travelers, fishes in swift streams must swim fast to stay where they are. To meet their varying conditions of life, fishes have achieved almost perfect body design



AMNH photo by T. L. Bierwert

Mako

A new exhibit just completed at the American Museum

Spectacular in its ability to leap as high as the masthead of a fishing boat, or approximately 12 feet into the air, the Mako shark is described as the most difficult fish to boat by Michael Lerner, who caught the 602-pound specimen from which the exhibit was modelled. Here it is shown in the normal pursuit of its food, ready to clamp its sharp-toothed jaws upon an unwary albacore. In the background, beneath the yellow sky of early morning, other albacores break the surface. The Mako has been known to wreck deck and cabin of a fishing launch by its terrific lunges. This specimen was boated off the Bahamas after a sixteen-minute battle. The group was executed by the Museum's Department of Arts and Preparations under the direction of Dr. James L. Clark and Mr. Albert E. Butler.

RAINBOWS OF ROCK

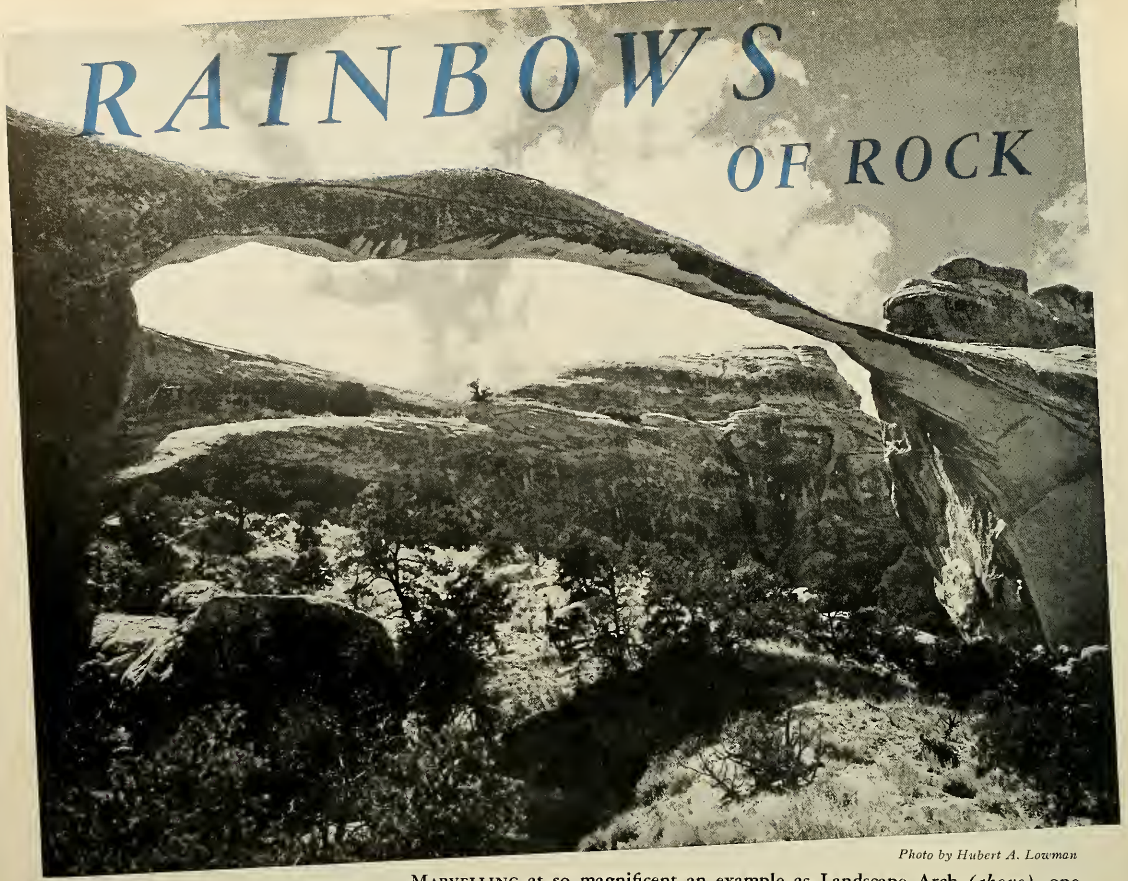


Photo by Hubert A. Lowman

Marvelling at so magnificent an example as Landscape Arch *(above)*, one may well wonder why Nature carved so many of these spectacular bridges within a radius of a few hundred miles. The curious purpose they served is a key to the interpretation of our arid Southwestern landscape. This span, in eastern Utah, is 291 feet long

By H. E. Vokes
Associate Curator of Fossil Invertebrates
The American Museum of Natural History

Any traveler who has seen the great gorge of the Grand Canyon, the snake-like course of the San Juan river through the "Goosenecks," the tall spires of Shiprock and Monument Valley, or the brilliant colors of the Painted Desert and Bryce Canyon will surely agree that Nature seems to have considered this desert region a "gallery" for her sculptural masterpieces.

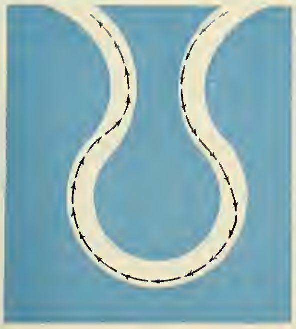
Each of these scenic wonders is a classic example of its kind. But with typical perverseness Nature has hidden the most unusual of these wonders in the most inaccessible parts of this inaccessible region. Here on the great platform of northern Arizona and southern Utah—a platform so intricately dissected by narrow, steep-walled box canyons that travel across its surface is almost impossible—she has carved the greatest natural bridges in the world. The security and isolation of these giant rainbows of stone might almost be interpreted to mean that Nature has deliberately placed them where only those willing to pay the price of hard and arduous travel may be permitted to gaze upon her ultimate masterpieces of beauty.

Nature and Man both build bridges. When Man does so, he is concerned first of all with the utility of his work. His bridges are built upon the most traveled highways of the world. Beauty is of secondary importance. Nature's greatest bridges span streams that one could almost leap across; and to us, beauty is pre-eminent, utility seems non-existent. But from Nature's point of view, utility is well served by the gap under the bridge, for through it the stream is enabled to flow by a shorter route to its ultimate destination. Thus, Man is particularly interested in the upper, traveled surface of his bridges; Nature, in the open span beneath them.

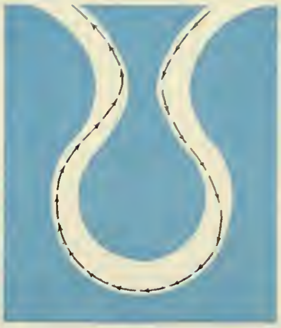
How Nature carved them

The story of the formation of these natural bridges is one that is easily deciphered and understood. The

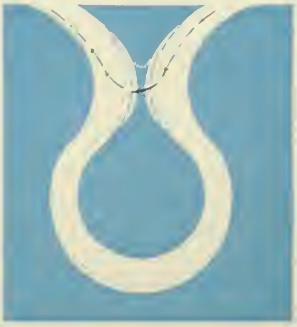
HOW A NATURAL BRIDGE IS CARVED



▲ A WINDING RIVER in a canyon cuts mostly along the outside curves



▲ IT CUTS faster if softer rock is met. Note that the loops nearly touch

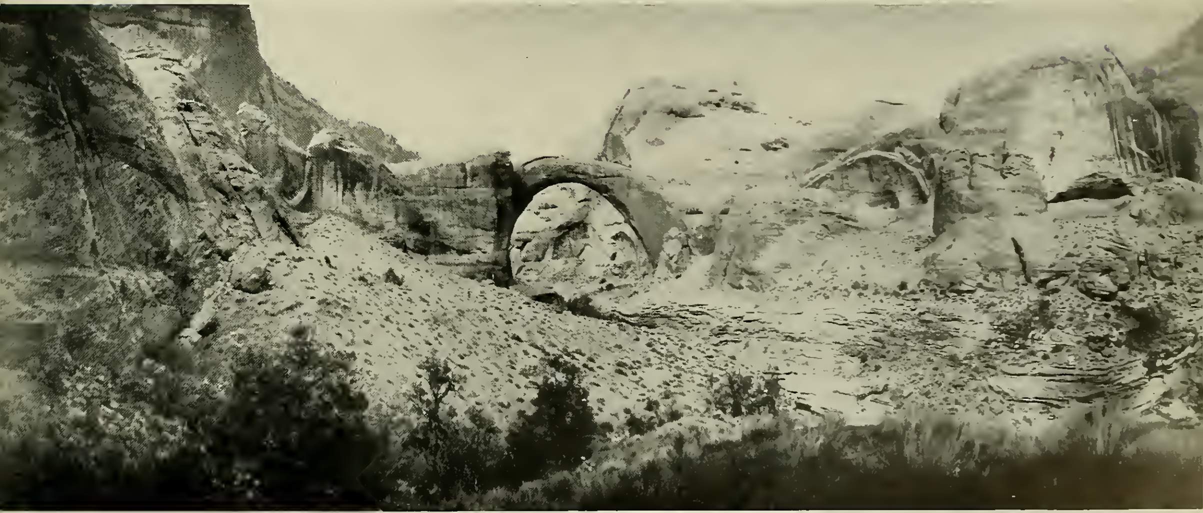


▲ BREAKING THROUGH, it flows under a rock bridge, abandoning the loop

Goosenecks of the San Juan, as explained in our story in the May issue of NATURAL HISTORY, owe their development to the fact that a broad, flat plain, across which the ancient San Juan River flowed in a winding course, was slowly uplifted, and that the river incised its crooked course as the land rose. Now it so happens that the ancient San Juan was not the only river crossing this great plain at that time. Among the others was one which today is known as White River, located about 30 miles north of the Goosenecks; and another one was located about 70 miles almost due west of them. Both of these streams, meandering broadly, cut their crooked courses deep into the plain as it was uplifted to form a broad plateau. Both found themselves, along part of their course, cutting their canyon through a heavy sand-

▼ PROBABLY the most famous formation of its kind in the world, Rainbow Bridge is nevertheless difficult to visit, requiring a round-trip of about 30 miles on foot or horseback from Rainbow Lodge, near the Utah-Arizona border. The bridge is higher than the Capitol in Washington. To the right are two partly formed arches, where the river tried to cut through and gave up

United States Geological Survey photograph by La Rue



stone formation which was underlain by softer sandstones and shales. In at least two places along its course, White River formed a great loop, known as an ox-bow, flowing so sharply in a great circle around a peninsula of rock as almost to join itself again, there being only a narrow rock isthmus intervening (see diagram).

Now it is the rule that the current of winding streams always flows along the outer edge of the curves, and therefore they cut their banks on that side. This rule operated along White River, but when the stream was flowing through the heavy sandstone beds, it could not do a very appreciable amount of cutting along the massive walls. However, when it had cut down to the softer layers underneath, the walls began to retreat as the current gouged them out. The heavy sandstones were undercut from both sides. Finally the stream broke through and soon it had cut its channel through the gap—which was left bridged by the massive sandstone above. The peninsula of rock had in effect become an island, while the remnants of the isthmus remained as a bridge connecting the island to the "mainland."

How to estimate the age

Once the bridge is formed and the stream begins to flow under it, its subsequent story is clearly foretold. In times of flood the swollen waters not only deepen the river channel, they tear away at the buttresses of the bridge, tending to widen the span. This causes massive blocks of sandstone to "spall" off from the under side of the arch. The bridge thus becomes longer and higher above the river. But this causes the span to become more and more slender, and at some future date it will collapse entirely. Then the river will flow past the rock "island" between the remnants of the buttresses, which will serve as the sole monuments to the glory of the past.

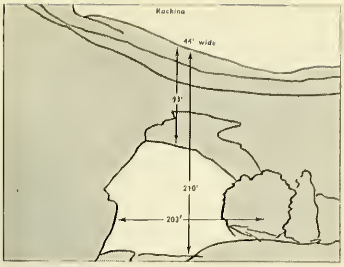
This history of the bridge is not hypothetical. In the drainage system of the White River there are today three great bridges that admirably illustrate the life history of the bridge itself, and in some trench-like cutoffs the observing traveler can distinguish the worn buttresses of fallen and forgotten monarchs.

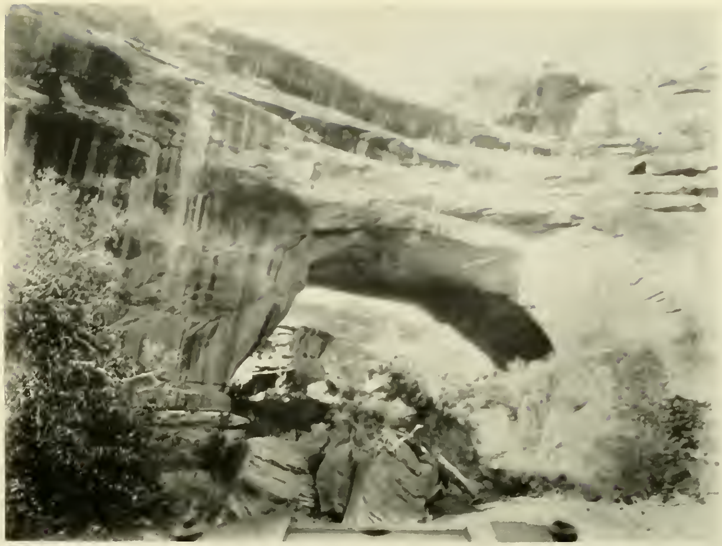
But while the bridges are thus, in terms of geological time, only ephemeral phenomena in terms of human existence they probably achieve hoary antiquity. On this, however, we cannot speak with any certainty, for spectacular though they be, they are among the most recently discovered scenic features of our country. While it is very possible that they may have been observed by trappers and prospectors as early as 1870, the first white visitor to report their presence was a miner named Cass Hite, who with an Indian guide, "Piute Indian Joe," spent several days during the autumn of 1883 prospecting in the upper canyons of the White River area. His stories of the bridges he saw there were so picturesque that he was soon followed by a number of pioneer settlers. But it was 20 years later before the outside world became aware of their existence. In 1903 Horace Long, a mining engineer, visited the region under the guidance of James Scorup, of Bluff, Utah. His illustrations and descriptions furnished the basis for an article in the *National Geographic Magazine* by W. W. Dyer, published in September 1904, which attracted so much attention that, on April 16, 1908, President Theodore Roosevelt set the region aside as the Natural Bridges National Monument.

The three spans which grace the area illustrate remarkably well the history of the typical bridge. The youngest and most massive of the three was called The Senator by Hite, and Carolyn (after the mother of James Scorup) by Long and Dyer. In the Presidential proclamation, however, the more appropriate Indian name, *Kachina,* was applied to it. *Kachina* is the guardian spirit of the Hopi Indians, and the symbol of the sacred dancers of that tribe was found carved upon one of the buttresses of this bridge. The youth of this arch is well shown by its massive thickness.

The largest of the three bridges is of middle age as compared with the others. Cass Hite called it President Bridge; Long and Dyer termed it Augusta after Long's wife; by Presidential proclamation it became *Sipapu* Bridge. The modern Indians of northern Arizona and southern Utah believe that they came into the world from a lower region through an opening which the Hopis call *Sipapu,* the door of life. After death they return through the same hole to the nether region, where they spend a period of purification before ascending to the sky to become rain-gods. The name seems particularly appropriate for the great sandstone gateway of White River Canyon.

The oldest of the three is also the smallest. It stands in Armstrong Canyon, a tributary of White. A slender, graceful strip of rock, it is perhaps the most beautiful of the three. In addition to its greater weight of years, it has stood up under four different names. Hite dubbed it Congressman Bridge; Long and Dyer unimaginatively termed it simply Little Bridge, but this name soon gave way to Edwin when it was so christened by an expedition sent out by the Salt Lake Commercial Club in 1905. President

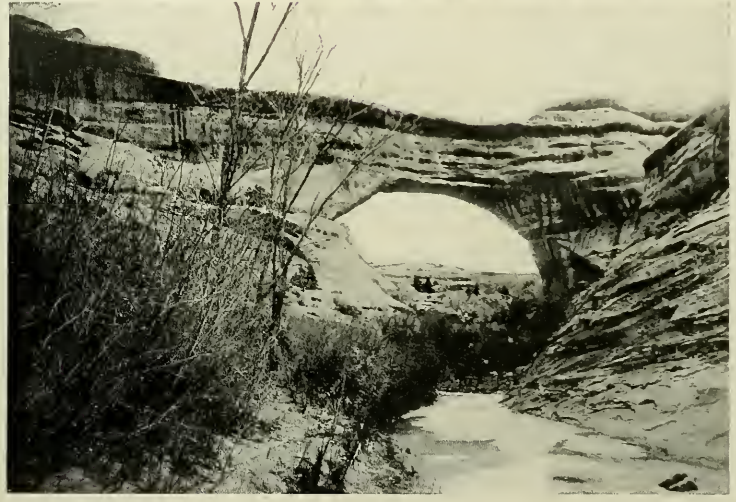

Kachina
44' wide
93'
210'
203'

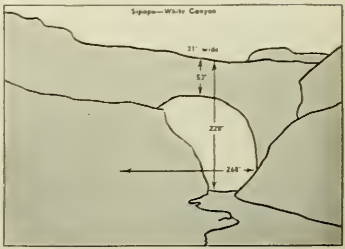


➤ THE THREE SPANS on this page illustrate well the history of the typical natural bridge. Kachina, the youngest, is the most massive, having suffered less from the ravages of time

United States Geological Survey photograph by W. H. Hopkins

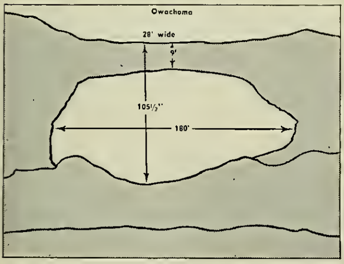
United States Geological Survey photograph by W. T. Lee



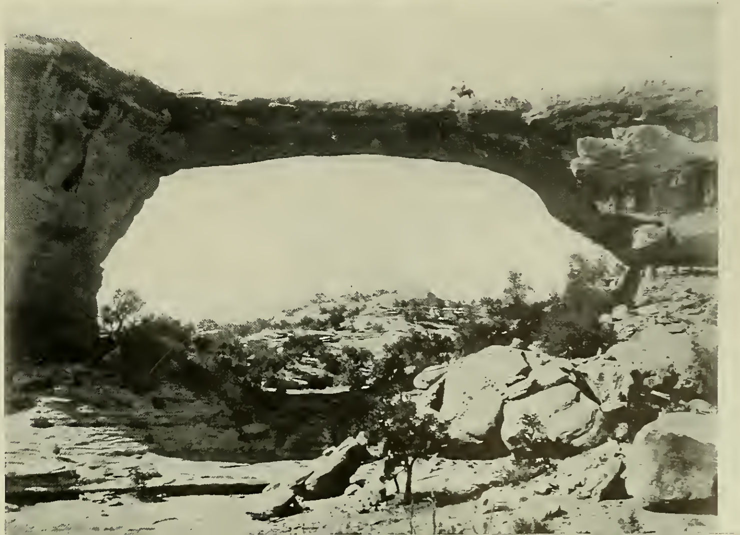

Sipapu—White Canyon
31' wide
53'
220'
268'

➤ THROUGH SIPAPU flows a river which formerly had to make a wide detour around the long buttress of rock it now pierces. More rock has been removed here, so the bridge can be classed as middle-aged. Note the small figures on top

United States Geological Survey photograph by W. T. Lee


Owachomo
28' wide
9'
105½'
180'

➤ THE OLDEST of the three is Owachomo, whose slender span speaks for its antiquity. In this region numerous remnants of bridges are also found, where the span, in extreme age, has collapsed



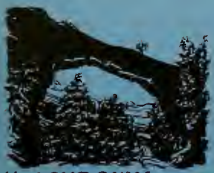
Roosevelt applied the Indian name *Owachomo,* meaning "flat-rock mound," derived from a near-by traditional Hopi lookout point.

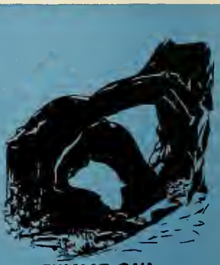
The extremity of old age is exceedingly well shown by the unusual Landscape Arch bridge of the Arches National Monument. In terms of geologic antiquity, it is living out its last days, soon to collapse and to be remembered only by remnant buttresses on the canyon wall.

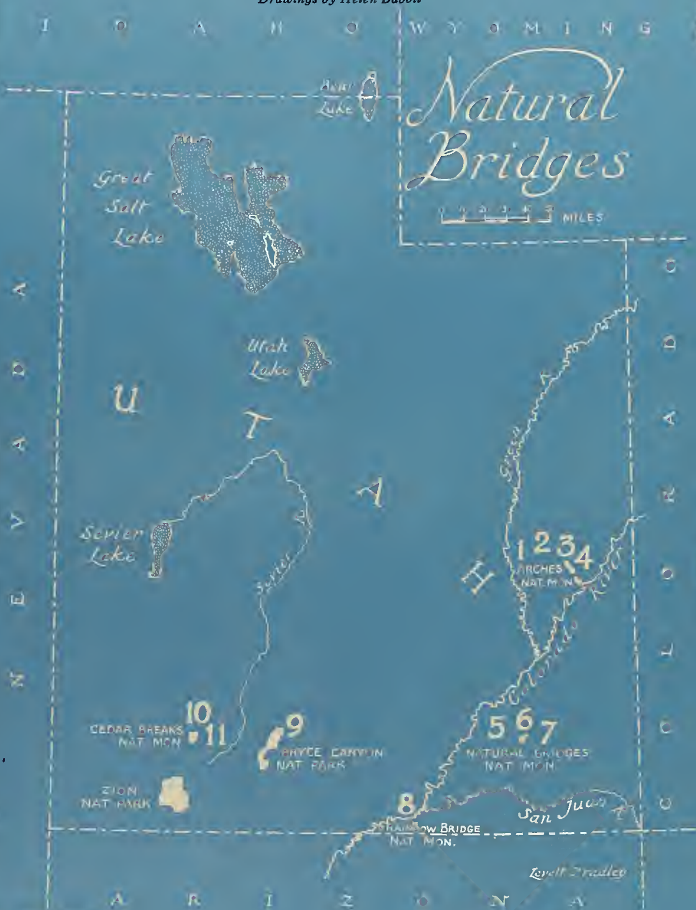
Other bridges are not rare in the great Southwest. The incomparable *Nonnezoshie* (Rainbow) Bridge of northern Arizona is more accurately called an arch, and in many ways it resembles a gigantic flying buttress of a great sandstone castle. It is larger than any of the three bridges in Natural Bridges National Monument. Rising 309 feet above the bed of Bridge Creek, it would easily span the dome of the National Capitol. The arch is 278 feet long, and at the top the rock is 42 feet thick and 33 feet wide. Smaller but no less beautiful bridges are found in the Cedar Breaks National Monument, near Bryce Canyon, and in the Arches National Monument. All have had an essentially similar origin—all are among Nature's supreme masterpieces.

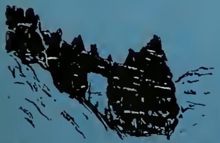
ELEVEN notable bridges and innumerable other minor ones are located in the southern half of Utah—a region which is undisputed champion in this respect. No accident of Nature is responsible for this abundance, but a combination of topographic and climatic circumstances, intimately connected with the history of the landscape

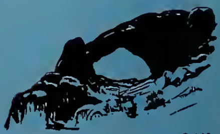
Drawings by Helen Babbit

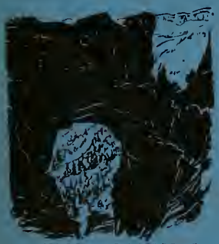

11 ASHDOWN

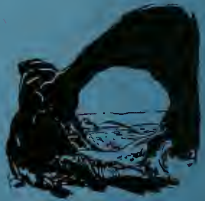

1 TWINBOW

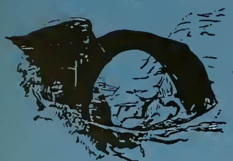

Natural Bridges
MILES
IDAHO
WYOMING
Bear Lake
Great Salt Lake
Utah Lake
UTAH
Sevier Lake
Sevier
Green
Colorado River
COLORADO
NEVADA
1 2 3 4
ARCHES NAT. MON.
10
11
CEDAR BREAKS NAT. MON.
9
BRYCE CANYON NAT. PARK
ZION NAT. PARK
5 6 7
NATURAL BRIDGES NAT. MON.
8
RAINBOW BRIDGE NAT. MON.
San Juan
ARIZONA

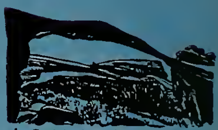

10 WALLS OF JERICHO

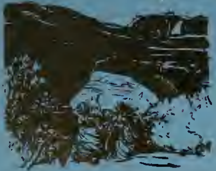

2 SOUTH WINDOW

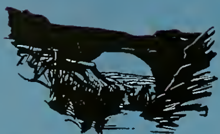

9 BRYCE CANYON

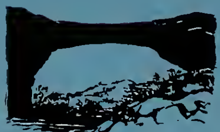

3 DOUBLE-O


8 NONNEZOSHIE (Rainbow)


4 LANDSCAPE


7 KACHINA


6 SIPAPU


5 OWACHOMO

Knothole Cavern

By Edwin Way Teale

All photographs by the author

The nighttime exploration of a Lilliputian lake carries a modern Gulliver far back through the pages of history and enables him to witness the truth regarding one of man's oldest misbeliefs

It was ten o'clock at night and the month was September.

All around me, bushes and twisted trees—so familiar by daylight—stood mysterious and still, massed in silhouette against a faintly luminous sky. The night had engulfed in blackness the Long Island hillside where I had set out an insect garden filled with plants and shrubs to attract six-legged visitors. All visible life was concentrated into the little area illuminated by my flashlight.

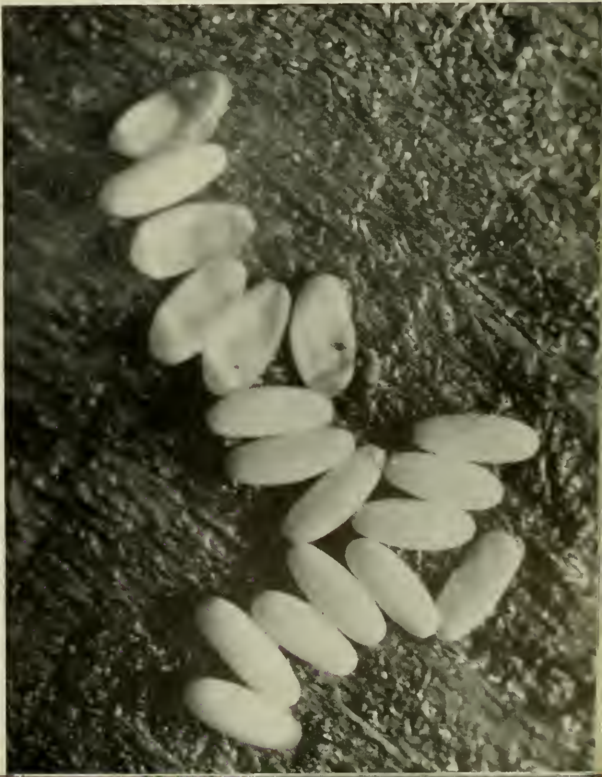
Like an elongated finger, I moved its beam among the jungles of grass, across the bushes, into the trees. As the light swung from place to place, successive little realms of insect life were spotlighted in its rays. These worlds materialized and vanished with the pressure of my thumb.

At times when I have been traveling by train on stormy nights, I have caught occasional glimpses of unfamiliar landscapes illuminated for a moment by flashes from the sky. They appeared and disappeared in an instant and they left me wishing I could see more clearly these isolated spots picked out at random by the chance glare of a thunderbolt. Something of the same feeling comes on nights when my beam shifts from point to point as I go exploring among the nocturnal dwellers of my garden. But there I can hold the lightning, so to speak, and keep the beam of my torch illuminating some scene of special interest.

Beneath an ancient apple tree, which has lifted its twisted branches above the hillside for more than half a century, I switched on the light. As the beam glided upward along the gray treetrunk, it encountered the black, unblinking eye of a knothole. A dozen times a day, in full sunlight, I had passed this opening without a second glance. But now, surrounded by darkness, this three-inch opening, five feet from the ground, assumed an added interest.

Rains from previous showers had collected within. The interior of the knothole, illuminated by my flashlight, resembled some subterranean lake, reduced with its underground cavern to miniature proportions. The weathered wood, sloping downward along the roof of this teacup-sized cave, had the appearance

▲ "As the light swung from place to place, worlds materialized and vanished . . . The beam encountered the black, unblinking eye of a knothole . . . like a subterranean lake reduced to miniature proportions"



The tiny snow-white eggs might not attract attention if one did not know what a curious diver would emerge of shelving rock. Half a dozen sow bugs, like trilobites from a remote geological past, glided away on the flowing action of a succession of slender legs to crowd into the darker corners of the cavern. Two black ants were bending down at the edge of the water as though drinking on the shore of a lake.

Floating on the surface of this knothole pool was the body of a dead crane fly. While I was peering at it, I caught a glimpse of one of the sow bugs hurrying from one dark corner to another with a baby sow bug clinging to its back. Under the lip of the opening, where I had missed them before, I saw a dozen grayish midgets, hardly more than an eighth of an inch long. Hanging from the surface film by the tips of their tails, they swung back and forth in steady, leisurely arcs. They brought to mind acrobats on gymnasium rings. Two, side by side, were swinging in unison—first this way, then that. What were they? What were they doing? The best guess I could make was that they were some sort of immature gnats living out the underwater stage of their existence.

All around them, and all through this knothole cavern lake, were the lighter-colored, more active forms of the mosquito wigglers. Like slender, whitish tadpoles, these larvae moved with lashing tails. They started, stopped, darted forward again, whip-tails in action. They were the most numerous of the midget fish that swam in this Lilliputian pond.

Rising from the debris at the bottom of the flooded cavern were a score or more slender white stalks, apparently sprouts from seeds scattered singly and in little clusters. Between these pale vertical columns rising through the brown water, the tiny wigglers kept up their incessant and seemingly aimless darting and pausing.

As the beam of my flashlight shot low over the surface of the water, I observed a curious thing. The surface was not smooth. It contained a dozen dimples that suggested the "knots" in an imperfect pane of glass. Under each dimple hung from one to seven of the white sprouts. Where there were more than one, the thin stalks came together like the poles of a tepee. Some attraction seemed to pull them to a common center. Using a straw, I pushed apart one of these clusters. With a steady, stately motion, the component stalks swung back and assumed their former position.

The dimples above such clusters were larger than where a single sprout reached the surface. And here was another surprising thing. Not a single sprout had pushed above the water. All reached exactly to the surface and no farther. I was puzzling over this when an amazing thing took place before my eyes.

As I watched it, one of the white sprouts telescoped slowly downward, like a movie run in reverse. It steadily became shorter until it disappeared in the debris below. The other stalks remained as before. The whitish wigglers kept up their endless darting and halting. And the little acrobats of the surface film continued swinging back and forth in rhythmic oscillations.

World's first diving suits

But something had happened at the spot where the descending sprout had reached the debris. Half an inch of white was moving among the black decayed wood of the pond-bottom. In a flash, I knew. These were no sprouts. These slender, stalklike columns were the air-hoses of the world's first diving suits. At the bottom of my knothole cavern were not seeds but some of the strangest, most incredible children of the insect world.

These larvae of *Eristalis tenax,* a syrphid fly popularly known as the drone fly, feed upon decaying matter in such shallow pools of water. Their tubelike, telescoping tails reach to the surface and carry air to the creatures below. Aeons before man first appeared on earth, Nature thus invented the prototype of the diving gear. Reaumur, the great natural scientist of Eighteenth Century France, studied this curious larva and gave it its name. He called it "the rat-tailed maggot" and the name has stuck.

Although these whitish creatures are, at most, only two-thirds of an inch long, they can extend their remarkable tails as much as four inches to reach the surface air. In his pioneer experiments, Reaumur placed several larvae in a jar and added water little by little. He saw the extensible tails, formed of two tubes telescoping one inside the other, lengthen until they were eight times as long as the bodies of the creatures they supplied with air. When they had stretched to the limit, the tails were no thicker than horsehairs. If additional water were added, the larvae either crept up the side of the vessel or floated nearer to the surface within reach of the air supply.

Since that night when I first met *Eristalis tenax* in my knothole cavern, I have observed other phases of its strange life-story. I have found the snow-white eggs floating in rafts on the surface film of the brown water. I have seen and photographed the long-tailed larvae as they hatched. I have discovered over-wintering larvae frozen in solid cakes of ice and have thawed them out and seen them swim about unharmed. I have observed these curious creatures walking along the underside of the surface film, like a fly traversing the ceiling of a room.

In feeding among the decaying matter at the bottom of the knothole pond, the larvae make use of tiny hooklets, which are attached to a head that is soft and capable of changing its shape. Other hooklets form a double circle on the bottom of each of twelve of its fourteen stuffy feet. On the front pair of stubby legs, the hooklets point forward like fingernails.

At the end of its larval-period, the rat-tailed grub leaves the water. It changes from white to yellow. Its body becomes shorter and thicker. Its larval skin grows hard and opaque, forming the puparium within which the transformation into the adult fly occurs. Two pairs of horns develop at the head of this pupal case. They provide respiratory organs for the period of transformation.

The ancient myth

This period lasts from eight to ten days. At the end of that time, what appears to be a honeybee crawls from the pupal case. In size, shape, color, and furry thorax, the adult syrphid fly so closely resembles a bee that it has helped create one of the most persistent myths of science, the widespread belief in the ox-born bee. Such flies are often seen about the carcasses of animals, in the fluid of which they deposit their eggs. The ancients, mistaking them for honeybees, concluded that the latter were engendered in the decaying carcasses of larger animals.

Osten Sacken, the Russian scholar who devoted years of painstaking research to the study of this myth, shows how the misconception was shared by peoples in many parts of the world. More than half of the fourth *Georgic* by Virgil is devoted to a detailed description of the most efficient method of producing bees from oxen. Ovid relates how the death of one produces a thousand lives when a slain ox becomes a swarm of bees. In his *Geoponica,* Florentinus goes into minute detail in explaining how to produce the finest bees. A bullock, he states, should be beaten to death with clubs and its bruised body shut up in a room with the windows plastered over. After sprinkling thyme and cassia over the dead bullock, the carcass should be left in the closed room for from two to three weeks. At the end of that period, this ancient writer assures his readers, nothing will be left of the animal except the horns, bones, and hair. The flesh will have changed to great clusters of honeybees.

Even before the days of the Latin scholars, the Greek writers were referring to the ox-born bee in their epigrams. Archelos called bees "the streaming children of the decaying ox." Nicander declared that "wasps are the offspring of horses, as the bees are of oxen." Because of this fancied connection between bees and oxen, the ancients considered that the best material for smoking bees was ox-dung. In that fascinating catch-all of superstition and early science, the *Natural History* of Pliny the Elder, we learn that if bees die, they can be renewed by burying the carcass of an ox in dung.

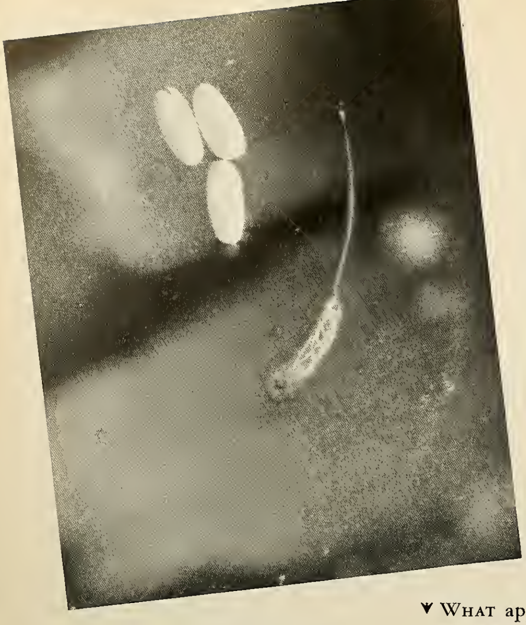
Long before the rise of Greece, Egyptians along the mouth of the Nile went through a laborious ritual in producing bees from oxen. They buried the slain bullocks in the ground with only their horns sticking out. The horns were then sawed off. From these openings, as the carcass decayed, the bees were supposed to fly. Chinese and Japanese writings reveal that the idea of the ox-born bee was current in the Orient at a very early date.

In 1474, a book by Peter de Cresentiis suggested that bees might be "partly produced by bees and partly from decayed oxen," and the myth that a honey-gathering swarm owes its existence to the death of an ox has persisted until comparatively recent times. In fact, in remote sections of the world, it may still be accepted as true. The myth of the ox-born bee is one of those contagious misconceptions which have spread to many parts of the globe. It stands as a monument to the intellectual sloth of mankind. For the simplest kind of an experiment—an attempt to obtain honey from such insects—would at any time have proved its falsity.

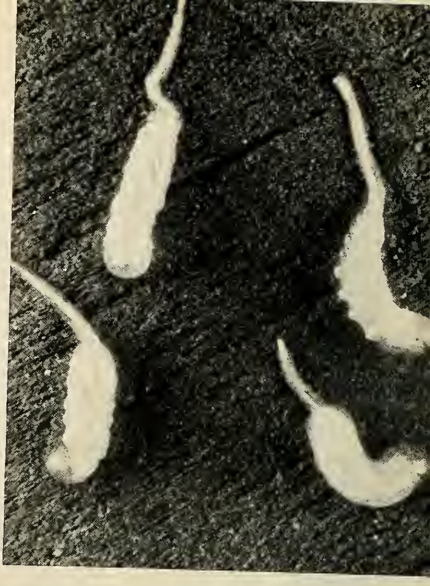
A hitchhiker

Flies aplenty are produced as the ancients described, but not bees. Like the legend for which it is responsible, the fly, *Eristalis tenax,* has spread from one country to another. As a stowaway on shipboard, it has traveled widely. About the time of the Civil War the drone fly and its rat-tailed larvae were first recorded in America.

If not the identical species that Virgil and others had erroneously described as bees produced from oxen, the underwater larvae of my knothole with their telescoping "periscopes" were their close relatives. Instead of in decaying flesh, they developed in the decaying matter at the bottom of a knothole. The accompanying photographs show the knothole and what I found in it, as well as an adult syrphid fly, which later alighted on a flower nearby. You will note that an observer, particularly in the early days of natural science, might suppose that it was a bee. For me, the story of these insects took on added interest, because I had picked up the thread of their history under unusual circumstances, because within the space of a knothole cavern my flashlight had illuminated the silent drama of their early lives.

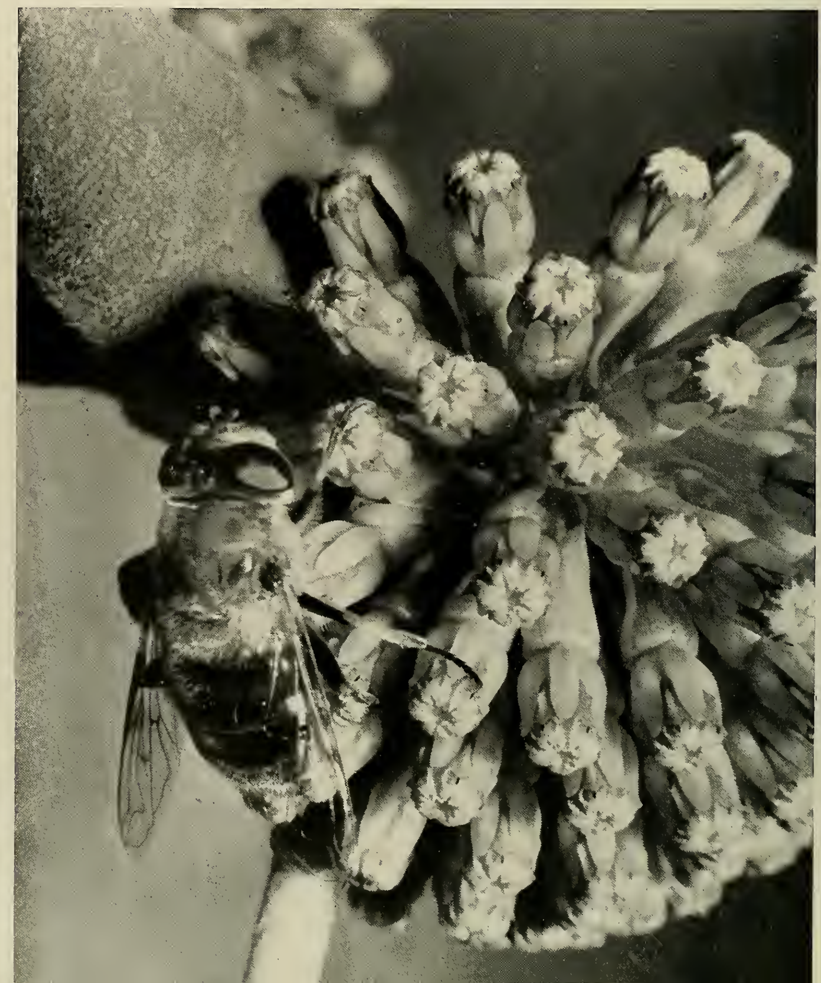


< EQUIPPED with an air-hose that telescopes out to eight times its body length, the little animal maintains contact with the air at the surface of the water. When extended to the limit, the tube is no thicker than a horse-hair

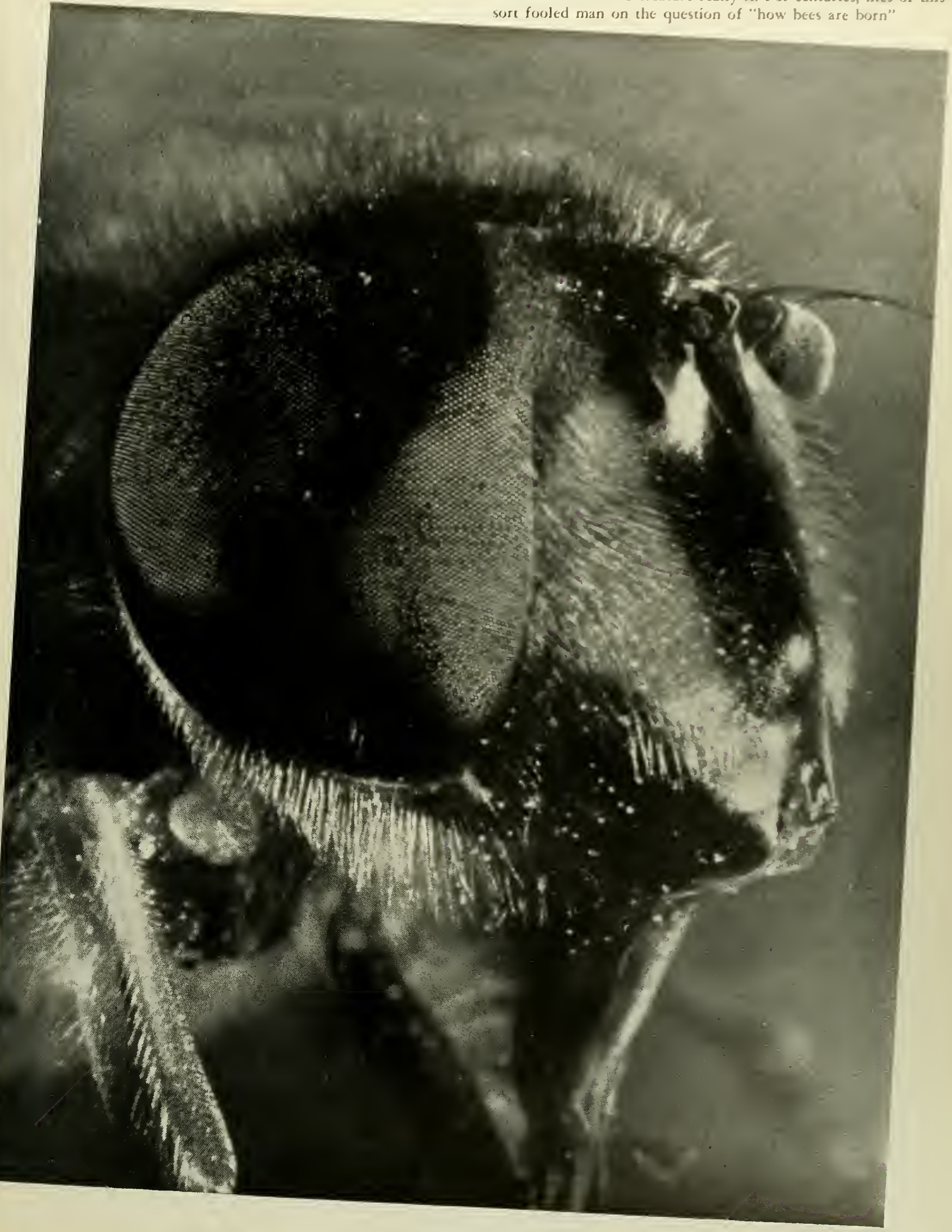


> THE LARVAE feed on decaying matter and by a remarkable transformation become winged creatures in due time

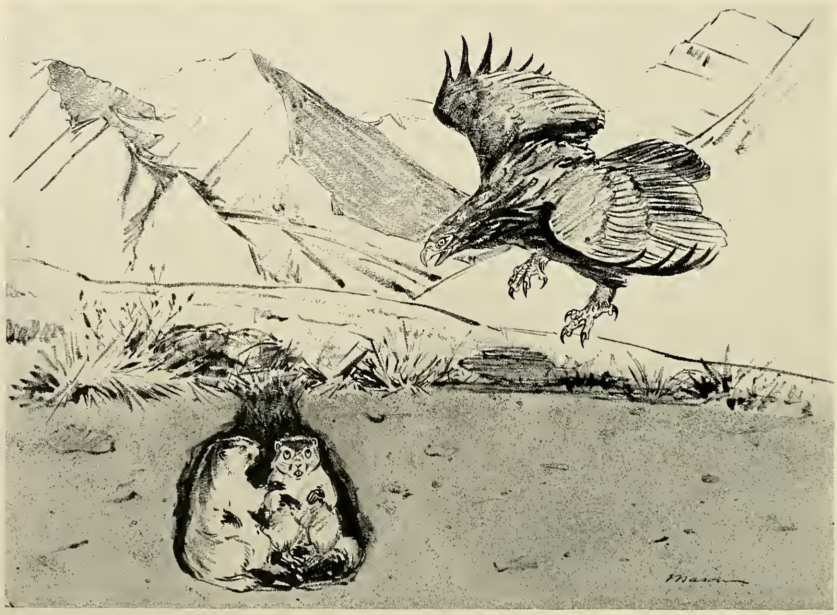
∨ WHAT appears to be a honey bee crawls from the pupal case. The ancients could easily have proved that it was not one, by trying to obtain honey from it



GREATLY ENLARGED, the head of a male syrphid fly looks more formidable than the creature really is. For centuries, flies of this sort fooled man on the question of "how bees are born"



AIR RAID SHELTER



By JOHN ERIC HILL

Drawn by

G. FREDERICK MASON

IN times like the present everybody is conscious of the menace of attack from the air and the need of shelter. Many animals, too, have aerial enemies from whose swift attack they need protection. Meadow mice use grassy runways to escape the hawks and rarely come out into the open. Pocket gophers spend most of their lives in underground tunnels because of similar foes. But the hoary marmots, huddled in the shallow shelter-hole to escape the eagle, show the closest resemblance to men in an air raid shelter.

Hoary marmots, or whistlers, are larger, grayish cousins of the woodchuck. Their silky fur is creamy white, mixed with blackish, except for the rump which is rusty and the feet which are black; and they are among the most handsome rodents of North America. They are found in the western mountains, from northern Washington and central Montana to Alaska. In the southern part of this range the hoary marmots are restricted to the mountains above timberline, but in Alaska they occur near sea level.

These two marmots were feeding on the lush grass and tasty weeds of the mountain meadow. They wandered farther and farther from the safety of their home burrow, which was at the edge of the meadow, eating greedily until their paunches bulged with the green food. (Marmots must put on thick layers of fat for their long winter sleep.)

A golden eagle, sailing high in the air, sighted the busy marmots and wheeled in their direction. The far-off movement was seen by an old marmot, resting on the top of a boulder. Immediately the watcher gave a piercing whistle of warning. All the marmots of the little colony dived for their burrows; but the two out on the meadow were too far away from home, and the eagle was coming on like a bolt of lightning. The shallow hole was near, and the two tumbled into it with not a moment to spare.

The home burrow of the whistler is usually under and among large boulders or in rock slides, where they cannot be dug out. They often have shelter-holes along the pathways that lead from the burrow—holes which were perhaps dug in play by young marmots or perhaps started as homes and abandoned. Whatever the origin of the holes, they are good protection from the eagle, provided the refuge can be reached in time, and the golden eagle is one of the chief enemies of these rodents. The frightened marmot, however, that runs into one of these shallow holes to escape a grizzly bear, its other major enemy, is almost certain to fall victim to bruin.

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A MONARCH AND HIS COURT

Saved from white man's ravages

By L. Conway Evans

In the heart of the Waipoua Forest in the North Island of New Zealand stands Tane-mahuta, greatest of kauri trees, a fortunate survivor from early times when he and his kind reared their giant trunks all over the land. But then came evil days when after centuries of sturdy growth the ruthless white man hacked and burned the denizens of the "Bush" which those he was pleased to regard as savages, had loved and reverenced.

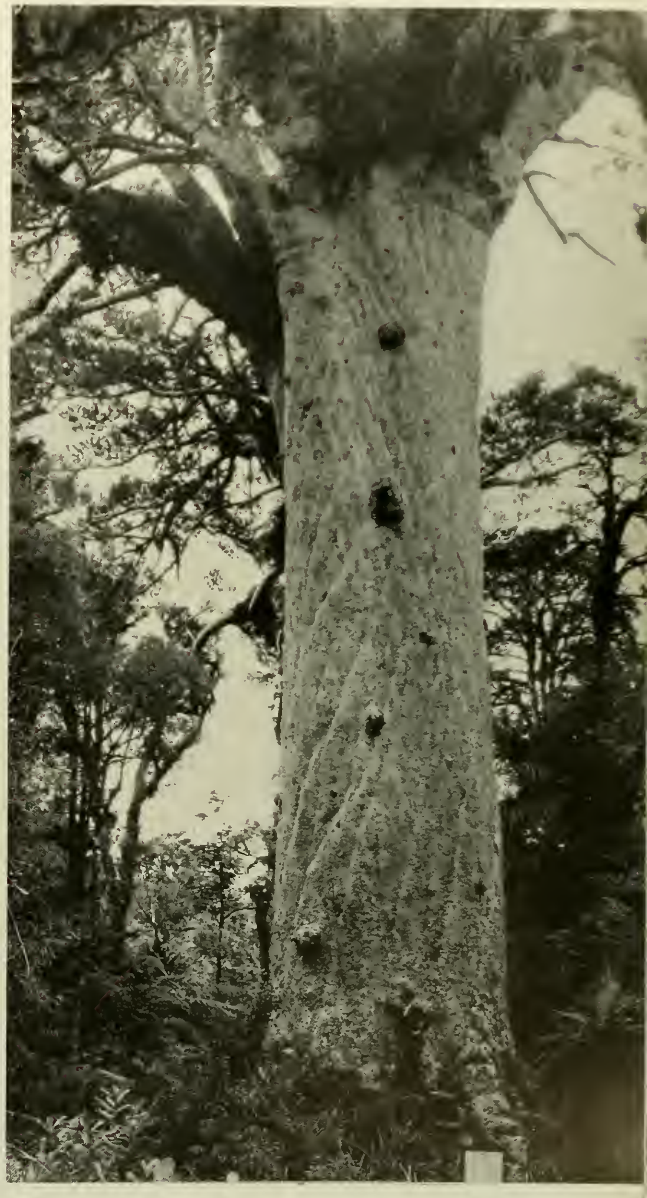
The Maori name Tane-mahuta means King, or rather God of the Forest, the original name of the deity who according to native mythology played a leading part in the story of creation. For in the beginning there was naught but darkness, night impenetrable. Mother Earth, known to her children later as "Papa" existed, but Rangi, the Sky, lay close upon her, and the gods who were awaiting birth lay crushed in the elemental embrace. There were many: Tane-mahuta of the Forest, and the gods of Winds and Storms, of Oceans and Volcanoes, of Earthquakes, of Peace and War, and with War was associated Man and warlike arts.

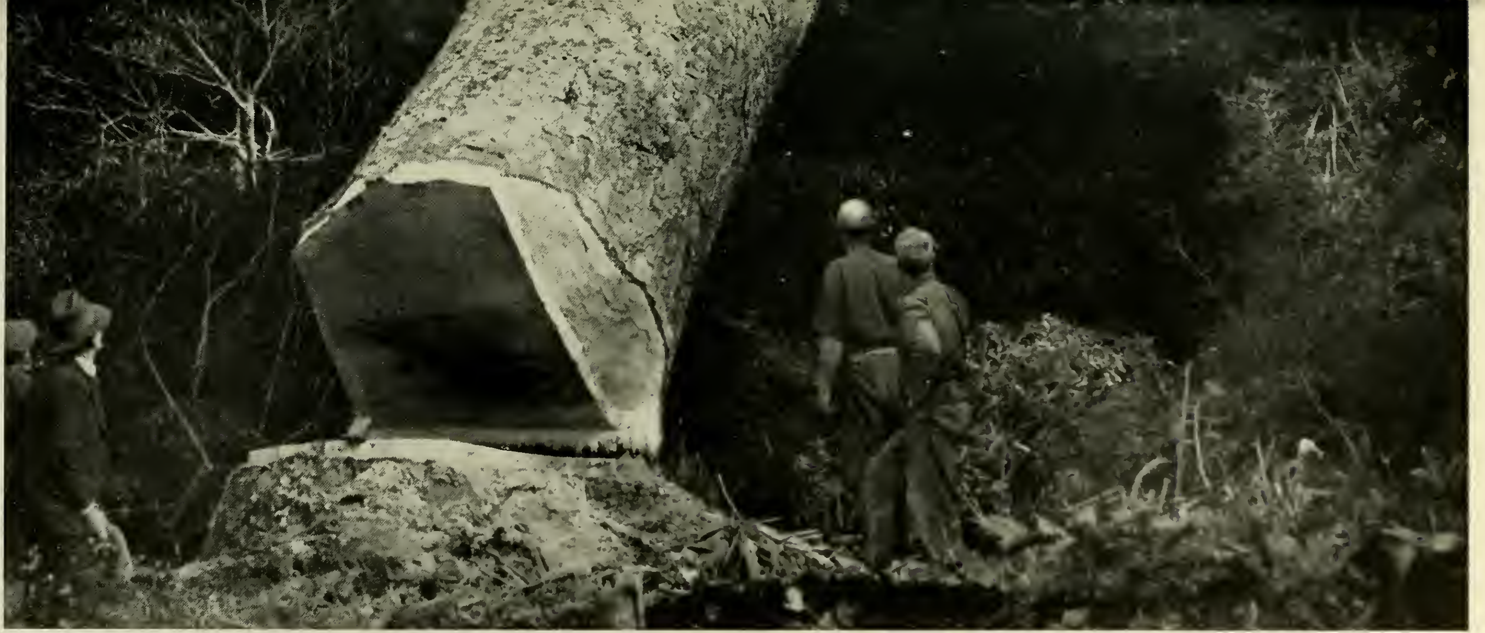
And it was Tane, as he is now generally known, who was the liberator, Tane, God of the Forest, who caused his mighty primeval trees to force his parents apart so that light flooded the world and the gods were freed. No wonder then that he was worshipped and his children venerated in the forest which was sacred, or *tapu.* But sometimes the Maoris would require the services of one of the giants. If they had to build a new war canoe they needed a long straight tree trunk, but before chopping it down they had first to invoke Tane and then propitiate him, and the whole ceremony of felling was carried out under the direction of a priest of the tribe and enacted with much ritual. The threatened trunk was struck with a stick to which a leaf was attached, a special fire was kindled in which the first chips were burned, the relays of fellers who worked with stone adzes were themselves *tapu,* wearing but one garment apiece made for them by the older women of the tribe, and eating no food while employed on this task, which no woman might witness.

Ignorant of all this, an early French expedition led by Marion du Fresne met with its doom in the dense Bush. New spars were needed, and spars were made out of wood, a very usual and prosaic commodity. The Frenchmen found marvelous forests with trees the like of which had not been seen by Europeans before, for Cook had not penetrated sufficiently far inland to discover them. They were enthusiastic about this "kind of cedar with the leaves of an olive color and very resinous. The resin is white and transparent and gives out an agreeable odor when burned." Pleased with their find they proceeded to destroy. But Tane had been outraged, and the Frenchmen paid for their sacrilege with their lives.

And who can tell how much of the bitterness of

▼ As a monument against destruction of natural resources, Tane-mahuta raises its purplish gray trunk 42 feet into the air without a single branch. Note the man at the base, dwarfed in comparison with the tree's 43-foot girth. This is the largest kauri tree in the world, and it has lived well over a thousand years





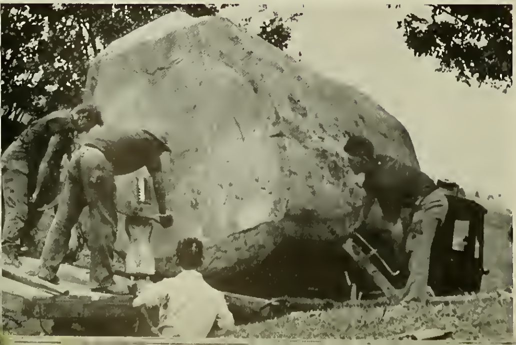
▲ **Although** this lesser giant was flourishing when Columbus discovered America, man now deems it necessary to fell it

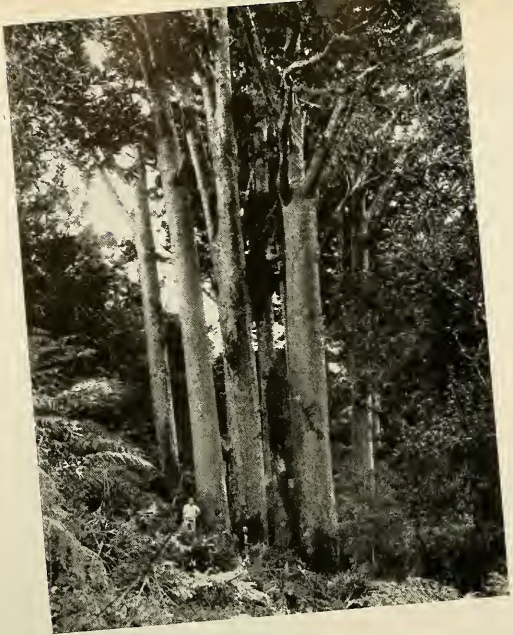
A. N. Breckon Photos from Three Lions

▼ **It takes** four men to jack this huge kauri log onto a truck for transport to the mill. Note the clean surface of the tree. From time to time the kauri sheds great flakes of bark, leaving a clean surface pitted with strange patterns in which some have seen the original designs of many native New Zealand carvings

▼ **In the** early days bullock teams were used to bring out the logs where there was no suitable waterway. Now tramways have been laid down through the kauri forest areas, but the colorful bullock team still persists in some localities

▼ **Opening of a** dam will wash these hundreds of kauri logs down stream to the milling plant. A single kauri has been known to produce as much as 72,000 feet of lumber





▲ "TOUCH NOT a single bough"—a clump of kauri trees protected in the Waipoua State Forest in New Zealand, whose vertical shafts stand as a lasting symbol of the majesty of this unique tree and of man's forethought

the Maori Wars, now happily relegated to the past, had their literal roots in the wanton destruction of Tane's sacred kingdom? Today there are miles and miles of waste land quite unsuitable for pasture, with blackened stumps to tell of a destruction whose ruthlessness is only paralleled by its stupidity. Native trees of all kinds have been sacrificed, but the destruction of the kauri is the saddest of all because of its slow growth. Should a young man plant a seed from one of the tiny cones he would not see much result during his allotted span of life, and experts are willing to accord an age of 1200 to 2000 years to the giants which still remain in the now fortunately preserved areas such as Waipoua Forest and Trounson Park.

It is in the former that Tane-mahuta holds his court. Main road and motorcars are left behind. The approach is by a path paved with the hairy trunks of tree ferns through a tangled wood of incomparable beauty. Trees of many varieties are roped together with lianas and offer their bare bodies to innumerable ferns, mosses, and epiphytes. The forest is full of music, of the silver notes of the tui (parson bird), the gay rippling song of the gray warbler, the call of the shining cuckoo heralding his majesty. And there stands the hoary old monarch carefully protected by a stout fence from his enemy, Man, for as a companion aptly quoted:

> Fools' names and fools' traces
> Are always found in public places

—and vulgarians see nothing amiss in carving their ephemeral names on trees which may have existed when Christ walked in Galilee.

Their efforts in this case, however, would not survive for very long because the kauri has a wonderful protective measure by which it can rid itself of unwanted superfluities—an invaluable asset! That is the reason why, in a country in which nearly every other tree is smothered in the strangling embrace of parasites or bristling in epiphytes, the kauri alone stands out chaste and clearly defined. From time to time great flakes of bark are shed leaving a clean surface beneath, pitted with strange patterns in which some have seen the original designs of many Maori carvings.

A board records the actual facts concerning the monarch and tells that his girth is 43 feet, that he reaches a height of 42 feet before he puts out a branch, and that he provided 72,000 super feet of timber. This may be of interest to some. I would sooner remember his majesty than his measurements. But though he is the biggest of all the trees, yet perhaps his courtiers in Trounson Park show to better advantage, because there they have the place to themselves, and one sees the grandeur of the mighty purplish gray trunks as they stood throughout the centuries. Columns in a Gothic cathedral are often said to resemble trees in a forest. There is nothing Gothic about the kauri's growth. The trees are Norman in their solidarity and immense girth. The trunks soar upwards for some 40 feet before branches interfere, and the branches show their age far more than the trunks. The small leaves clustered around them, like those of the araucarian monkey-puzzle, are not especially beautiful. The cones, which bear male and female flowers on the same tree, are remarkably small, reminding one that colossi such as they and the giant sequoias are propagated by very tiny offspring.

Kauri gum

The fact that the trunks rear their heads aloft without tapering makes the trees of immense value, and the quality of the wood has a remarkable combination of strength, lightness, and durability. But apart from the value of the actual timber there is a by-product which has brought much wealth to man and has not necessitated destruction. That is the so-called kauri gum, which is a substitute for amber and is used in the production of first-class varnishes. It was the resin to which du Fresne made reference, and it oozes from the tree wherever wounded and trickles down from its crown. The flakes of bark that fall from the trunk are impregnated with it, and when they decay in the ground the resin becomes fosilized and is converted into the precious substance which was eagerly sought for by diggers in the past. These diggers—Dalmatian for the most part—collected it in dust, in chips, or in nuts. Fortunes have been made overnight when the collector has come round to buy up the yields en bloc. And they have been lost as speedily, for Dalmatian diggers were notorious gamblers.

But times have changed here as elsewhere. We live in a synthetic age, and it is a wise man who can tell from what anything is made. Tourists still buy the gum with strange creatures within it, but it is more an object of interest than of value.

Tane-mahuta has seen much in his long life.

Autumn's Brilliance on the New Kodacolor

By CHARLES H. COLES

Chief Photographer of the American Museum of Natural History

AS the vivid hues of fall foliage once again flash over the wooded hillside, we have a new medium with which to record these colors for future enjoyment. Kodacolor makes it possible now for owners of all roll film cameras (excluding miniatures) to make color shots and see them on paper as a print.

While the new color film is simplicity itself to use, a glance at some of its limitations may improve results. Although the exposure latitude of Kodacolor is far greater than that of Kodachrome, it must be remembered that a transparency is always superior to a print in its ability to record wide ranges of brilliancy. Many persons do not clearly understand this. A black and white film, for example, will properly record objects that differ in brightness by over 100 times, but this range is of small value if it cannot be transferred to the print. Ordinary printing paper will record a brightness difference of only 40 times; hence details that were recorded by the film in the extreme shadows and high lights may be lost on the paper. If this same film were printed onto a lantern slide and thrown on a screen, its full scale of tones would be preserved. This is the fundamental advantage of a transparency over a print on paper.

Kodacolor film has a large tolerance for exposure errors and brilliancy differences, but the paper upon which it is printed has the usual restrictions in brightness range. Therefore, if the original subject has great differences in brightness, the paper may not be able to encompass the entire range. Similarly in the use of Kodachrome, the brightness range of the transparency is apt to be greater than a Minicolor print made from it.

Thus the photographer using Kodacolor should remember that his finished print will appear more pleasing when the brightness range of the original subject is restricted to rather small limits, that is, when the brightest object is not more than 3 or 4 times as bright as the darkest shadow in which good color rendition is wanted. This difference can be measured with an exposure meter, and if it is too great it should be adjusted by the proper use of reflectors.

Taking pictures in full sunshine always presents the problem of excessive contrast. Suppose we are taking a photograph of the red fruit of the sumac, growing at the edge of the autumn woods with sunlight shining through the trees upon it. The contrast will be very high, ranging from full sunlight to deep shadow. A color picture of this subject can be exposed for either the high lights or the shadows, but not both. In order to raise the shadow side to an intensity comparable with that of the sunlighted side, it will be necessary to use a reflector. A piece of white paper or card will do the trick nicely or, better, a card covered with a sheet of metal foil that has been crumpled and straightened out again before being cemented to the card. The size of the reflector depends mainly on how large an object is to be photographed. The reflector catches the sunlight and throws it onto the shadow side of the shrub.

Startlingly beautiful color prints may be made almost entirely by the use of light from a reflector. Move around to the shadow side of a tall yellow goldenrod so that the sunlight illuminates only the outline of the flower. Now use the reflector just alongside the camera to redirect sunlight onto the plant. In this way a flat light will fall upon the flower and the sun will edge-light each spike of blossoms.

Almost all the most striking close-ups in color that you see in magazines are made with this combination of sunlight and reflector. With larger objects an exposure meter can be used to measure both the high light and the shadow brightness. It is then possible to adjust the shadow brightness with the reflector until it measures ¼ or ⅓ as much as the high lights. When this balance is achieved, good color rendition will be obtained in both the high lights and the shadows.

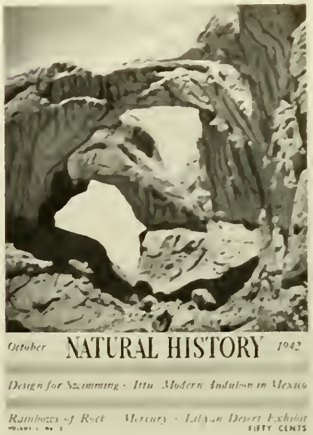
Almost any camera may be used for Kodacolor, even a box Brownie. The colors will, however, be rendered more accurately by a camera with a better lens, since the more complex lenses are corrected for better focusing of the various colors. What is more, the box camera can be used only in bright summer sunshine because of the small aperture of the lens.

Since Kodacolor is corrected for sunlight, any variation from this type of lighting will have an effect upon the color. The familiar bluishness of pictures made in the shade will remind us of similar effects obtained with Kodachrome. Here the use of a 2A filter will help to overcome the blue color of light coming from blue sky alone untempered by sunlight.

Kodacolor does not yet give as good color rendition as Kodachrome, but its deficiencies will doubtless be remedied in time, as was the case with Kodachrome. A great advantage of Kodacolor is that black and white enlargements can be made from it as easily as from a regular negative. It has been suggested that an orthochromatic enlarging paper such as Varigam be used to make the enlargements, so that you will achieve gradations of light and shade which closely match the brightness values of the colors recorded in the negative.

The greatest drawback of Kodacolor as yet is the inability of the manufacturer to supply large color prints. Kodachrome has this advantage. An enlarged print can be made from it by the Kotavachrome process in addition to the fact that the transparency can be projected on a screen as a lantern slide. However Kodacolor is the answer to the amateur's demand for an inexpensive color print which can be pasted in an album or viewed at any time without setting up a projector.

THE COVER THIS MONTH



"The Jug-handles" is the popular name for Twinbow Arch, depicted in full color on the cover of this issue. This remarkable formation is located in southeastern Utah, in the Arches National Monument, and can be reached by automobile over a winding, uneven road a few miles north of Moab.

The sun pouring through the enormous span plays strange tricks on the brilliantly colored rocks. Once thought to be a freak of nature, the structure is now known to have been carved by a river in search of the easiest route toward the sea. The gap in the larger arch is 165 feet wide and 156 feet high, and the total represents a tremendous weight of rock removed by the slow processes of erosion. There are 31 arches in this section of the Monument.

The Kodachrome was taken by Ralph Calvert, who used an Argus camera set at 1/60 second at f 6.3, with a haze filter. For further discussion of natural bridges and their formation, see "Rainbows of Rock," by H. E. Vokes, on page 148.

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- - - - - - - - - - by Emil Ludwig

Whittlesey House, $3.75

IN my opinion this may well earn distinction as the best of the many works by Emil Ludwig. Like *The Nile,* its subject matter is historical, being the history of the lands about one of the more important geographic features of our world. But the Mediterranean area is a larger one than that drained by the Nile River; its history is inevitably more complicated and even, in many ways, more picturesque. In the words of the author: "The Mediterranean is the loveliest of all seas, favored by situation, shape, and climate above all others, and likewise before all others discovered and sailed. This is the Helen among oceans; like her it was desired by all that saw it, and captured by the boldest. But it was fought over not for ten but for two thousand years. Then it was half-forsaken, obscured by the fame of new and distant oceans; rediscovered, as it were, after three hundred years; and today, before our eyes, it is fought over anew."

There is not much that is true "natural history" in the book, although there is some discussion of the physiography of the sea bottom and of the shore regions, together with a consideration of the various air and water currents, with particular attention to their effect upon the political history of the region.

The story of this book is the story of the growth of the civilized world as evidenced in the history of one of its great crossroads. From the days of the first communities of the East down through all the years to the great convoy battles of today, the Mediterranean has lived an eventful and kaleidoscopic life; as told here, it makes fascinating, entertaining, and withal, most informative reading.

H. E. VOKES.

THE AMATEUR SCIENTIST

- - - - - - by W. Stephen Thomas

W. W. Norton, $2.75

IN this time of national emergency it should be encouraging to all to know that there are many thousands of amateur scientists in this country. It should be even more encouraging to know that careful consideration is being given by national scientific organizations and by the government to the efforts and abilities of these amateurs. In this most scientific world the amateurs may supply the necessary bridge between the professional scientific field and the general public. Some of the many who "ride a hobby" may be surprised to know that their work is of such calibre that it can be considered scientific.

This book, which is in part a report of the study of amateur scientists in the Philadelphia area conducted by the Committee on Education and Participation in Science, of the American Philosophical Society, shows conclusively that the efforts of amateur scientists can be increased in value if those efforts are directed and co-ordinated.

The author is wise to point out early in his book the fact "that science is a neutral device and not an instrument that can be labelled good or evil." Thus, science, in itself, is no cure-all. However, free men and women who know how to use the scientific method can, if they will, use that method to add to the general well being of mankind. Readers of this book should be impressed by the fact that the Philadelphia experiment, in which 500 amateur scientists took part, was not only a success, but showed that amateurs were more than willing to devote their time and effort to a good cause without any consideration of compensation other than that afforded by the feeling of participating in a scientific endeavor. As long as the amateur American scientists are more interested in their work than they are in receiving compensation for that work, the future of American science seems fully assured.

JOHN SAUNDERS.

MAN'S MOST DANGEROUS MYTH: THE FALLACY OF RACE

- - - - - by M. F. Ashley Montagu

Columbia University Press, $2.25

THIS is a wartime book directed against the Nazi doctrine of the superiority of the German race. The general reader will not find it easy reading unless he is familiar with several divisions of knowledge. To state the thesis of a book in simple language is never quite fair, but it is not far wrong to state that the author stands for the literal implication of the Declaration of Independence that "all men are created equal." He believes this is worth fighting for and that we are fighting for it. He argues that there is but one race, the human race, and that all are potentially equal if given equal opportunities. He believes that animals and plants can be consistently classified biologically but that it is impossible to classify human beings in any consistent way. A taboo against the use of the word *race* is recommended, but "ethnic group" is regarded as the proper substitute. Yet why urge another name for what is said to have no existence? One way to eliminate race prejudice is noted, viz, to so mix populations that all will look alike and so lose knowledge of their ancestry. However, the author is far from sure that such a solution is desirable, if possible. One of his arguments against war is that it does not exist in nature, that when animals kill they are not making war nor fighting because they like it. Savage men, also, the author claims, do not make war when they raid and kill, but he maintains that war came in with civilization. Yet he thinks war is not a necessary part of civilization and so civilization need not be destroyed to abolish war. Readers enjoying argumentative writing will find the book provocative.

C. W.

THE CHANGING INDIAN

- - - - Edited by Oliver La Farge

University of Oklahoma Press, $2.00

THIS interesting discussion of the status and problems of the Indian of today consists of a symposium of seventeen papers arranged by the American Association on Indian Affairs. The introduction was written by John Collier, United States Commissioner of Indian Affairs. One of the papers, entitled "The Mixed-Blood Indian," was contributed by Dr. H. L. Shapiro, Chairman of the Department of Anthropology, American Museum of Natural History. The paper on "Land Tenure in Aboriginal America" is by Dr. Ralph M. Linton, Professor of Anthropology in Columbia University. There is not space here to mention each author and his contribution separately, but we must be content to state that all the contributors are among the foremost students of American Indian life. The editor, Mr. La Farge, is President of the American Association on Indian Affairs and is widely known through his books *Laughing Boy, The Enemy Gods,* and *As Long as the Grass Shall Grow.*

"There is more than paradox," says Doctor Shapiro, "in the fact that the American Indian has become an alien in a country once his by possession, and more than irony in the fact that he is looked upon as a social problem where his ancestors reigned supreme. But whether or not we object to regarding the Indians as a problem, their status has been reduced to that of a minority group, and their success judged by the degree to which they can assimilate our culture or come to some working terms with it."

The Indians are now increasing rapidly. Today there are about 380,000 in the United States; by 1980 it is estimated that there will be 700,000—perhaps a million by the century's end. How can these be supported on land that is not nearly adequate for the present numbers?

Some of the problems dealt with in this important book are the salvaging of the unfortunate land allotment, land use planning, and Indian health and education. It is the 23rd volume to be included by the University of Oklahoma Press in its excellent series of the "CIVILIZATION OF THE AMERICAN INDIAN."

CLYDE FISHER.

JUNGLE PEOPLE

by Jules Henry

J. J. Augustin, $3.50

THE jungle people of this book are the Kaingang (sometimes known as Botocudo) dwelling in the state of Santa Catarina in Brazil. A generation ago they lived a wild, nomadic life, making forays from time to time on the Brazilians and slaughtering them. Their existence was largely a struggle to gain a livelihood from the jungle with the primitive means at their disposal. To this extent the Kaingang are not especially remarkable, since many other uncivilized groups share with them similar preoccupations. The Kaingang, however, were remarkable in the extraordinary development to which they carried the feud. Within the same tribe families killed each other off to avenge one of their members. So fierce was this disruptive force that the passage of years did little to soften its power. Indeed, the feud seemed well capable of destroying the whole society. In the grip of its demands, no one felt safe except those who had ties established by relationships or by bodily contact through years of living and sleeping together.

If the feud tended to destroy their society, the female managed to hold it together by forming a nucleus around which one or more males might form a co-operative hunting unit.

Among the Kaingang the fundamental passions of life are reduced to their elemental forms and given full rein. Doctor Henry who lived (for more than a year) among these often savage people has written an account of their lives that highlights these elements. He gives his readers an absorbing "profile" of a jungle people.

H. L. S.

MY FRIENDS THE APES

by Belle Benchley

Little, Brown and Co., $3.00

MRS. BENCHLEY divides her book into four parts, devoting one section to each group of apes, beginning with the gibbons and progressing to the orangutans, chimpanzees, and gorillas.

She gives some interesting information about the history of each group of apes, using as authority for her statements the conclusions of explorers and students of natural history in this field. Her position as Director of the San Diego Zoo has enabled her to observe these animals constantly and over a long period of years. The gibbons are presented as graceful acrobats with an incredible sense of balance, which permits them to swing through the air and land with precision and instant repose. The sounds which the mother gibbon makes in crooning to her baby contrast remarkably with the clean ringing full-voiced song with which that same gibbon greets the dawn.

From Mrs. Benchley's experiences the orangutans show the greatest mechanical ability of all the apes; which combined with great strength, weighty bodies, and long arms to aid in leverage, makes it necessary for the keepers responsible for them to use great ingenuity in devising locks and bars which cannot be opened or pried apart.

The chimpanzees seem to have the least hold on Mrs. Benchley's affections—although she admits the appeal of these animals in babyhood.

San Diego Zoo has been fortunate in owning four gorillas, of which two are still living. These grand animals have Mrs. Benchley's whole-hearted admiration and affection. From their first arrival at the Zoo she has felt a sense of responsibility toward them and has kept a careful diary recording the smallest details of their behavior and appearance. Simple playthings have been provided and the animals have been happy, active, and healthy.

YVONNE RAVEN.

BIRDS ACROSS THE SKY

by Florence Page Jaques

Harper & Brothers, $2.50

THE Jaques can be counted upon to make a beautiful book, and this one maintains the standard set by their earlier creations.

Francis Lee Jaques is a master of the strong chiaroscuro of black-and-white, of which more than 25 examples illustrate and adorn his wife's sprightly text. Anyone who, after looking at such a plate as the widgeon among cypresses, on page 91, thinks that the medium lacks "color," must have a blind spot, indeed. His pictures skip far across the world, following the narrative from Alps to Canal Zone, from Alaska to the Gulf of Mexico. Aside from the beauty of line and mass, they possess other appealing attributes such as cold austerity in "Matterhorn," humor in the "Bird Club in Spring," and restrained pathos in "Grey of Falloden."

Diverse as is the content of the twelve chapters, at least two common threads run through them. These are: (1) discovery of the charm of birds by a sensitive adult under the influence of another who had been steeped in it since childhood; (2) emphasis on the observation, travel, intensive study, and technical skill that are demanded for building certain types of exhibits in modern natural history museums. Enjoying the advantages of a whimsical pen and the close companionship of her husband and his professional friends, Florence Page Jaques makes good use of her enviable opportunities. Persons and fascinating places are reflected as faithfully as birds and other wild life

Once in a while the author's memory slips a cog, as when she waves her husband off on a long Pacific voyage in a "thirty-foot yacht"—it was really longer by a hundred feet—, but in the main her descriptions are no less factual than artistic. So wide and rich is the geographic gamut, and so individual the charm of each event, that it might almost annoy her to hear this reviewer's opinion that the high spot of the book, in action, suspense, drama, and even in ornithological interest centers about a family of barn owls in the garret of an old manse only a few miles from the heart of New York.

R. C. M.

CLIMATOLOGY

by Thomas A. Blair

Prentice-Hall Co., $5.00

ARE you interested in the average temperature and rainfall for each month of the year in Pontianak, Borneo, in Zanzibar, Jerusalem or Rome, Archangel or Omaha? These facts are all to be found in this book. And not only will you find the actual figures, here also is a concise discussion of the climates of all parts of the world.

Doctor Blair, of the United States Weather Bureau Office at Lincoln, Nebraska, has written a book which from the viewpoint of the non-specialist is easily understandable, fully readable, and nevertheless almost encyclopedic in content. The subject is, in fact, the entire field of climates,—the agents which comprise them, the factors which influence them, their effect on agriculture, architecture, etc., and lastly a summary of the climates of the whole world. The compaction of all this material into a single volume, written in non-technical terminology and style is a monumental undertaking. Doctor Blair has succeeded in his attempt to achieve this goal.

H. E. VOKES.

KLEE WYCK

by Emily Carr

Farrar & Rinehart, $2.50

WHEN a schoolgirl of fifteen, Emily Carr with paper and paints first went among the Indians of the Canadian West Coast. These simple people with their colorful totem poles absorbed her attention for many years. She would undergo the greatest hardships in order to visit an abandoned village, where she could paint these poles carved from the trunks of trees. There seemed to be an aesthetic harmony between the native artist who made the huge carvings and the white girl artist who made the paintings of them.

As Emily Carr says, the totem-pole artist "wanted some way of showing people things that were in his mind, things about the creatures and about himself and their relation to each other. He cut forms to fit

Continued on page 168

Continued from page 113

Sirs:

I wish to express my appreciation of the magazine, Natural History. I find it utterly fascinating, and my only regret in receiving it is that I did not subscribe a long time ago.

It is good, in these trying times when one hears of nothing but the horrors of war, to pick up Natural History and find in it so many articles that do not let us forget there is still much beauty to be found in our world.

Dorothy Macneil.

Framingham, Mass.

* * *

Sirs:

Although it will mean stretching the budget, I feel that the renewal of my subscription for Natural History Magazine is one luxury that must be had. The past year's issues have been filled with information that has correlated wonderfully well with my natural science subjects. After finishing with one issue, it is passed on to members of the office force, and then it is sent home to my family, who can hardly wait until the next issue arrives . . .

Evelyn C. Roth.

Chicago, Ill.

* * *

Sirs:

. . . May I congratulate you upon the excellence of Natural History. From my point of view it is the finest magazine published in the United States today. The illustrations are excellent! The articles are exceedingly well written and interesting to read.

Ella Thea Smith.

Salem, O.

* * *

Sirs:

For several years I have been a subscriber to your magazine; I had it sent to me at the school where I was teaching in Evanston, Illinois, until a year or so ago, when I gave up teaching and then had the subscription transferred to the Library of William Penn College at Oskaloosa, Iowa. At the beginning of 1942 I was traveling in the West and neglected to renew this subscription (which I find is much appreciated by the college). Could you accept now the subscription for 1942, send the back numbers and those to come this fall, so that the year's issues can be bound? In any case, please continue the magazine . . .

Also I have heard of your Junior magazine. I have not seen a copy but I think I may wish to send in one or more subscriptions . . . If it approaches the regular magazine, I am sure it is good . . .

Mary G. Chawner.

Glennie, Mich.

* * *

Sirs:

Since writing you on the 7th of November last, I have duly received the copies of your magazine, which, I may assure you, I have read with the greatest of pleasure and interest. I have passed the magazine around amongst some of my friends who I knew would be interested.

I congratulate you most heartily on your most excellent and instructive journal.

Walter Leitch.

Melbourne, Aus.

* * *

Sirs:

. . . I do not want to discontinue this publication, because I do not care to miss even one number of it. Thank you.

Vincent J. Kelly, M.D.

Kankakee, Ill.

* * *

Sirs:

. . . We do not wish to miss any issues, for they will be invaluable to our children when they are older.

Elizabeth K. Worley.

South Hadley, Mass.

* * *

Sirs:

It gives me great satisfaction to apply for membership as an Annual Member for the first time. I have been an Associate Member on-and-off in the past years. I have been a student in the past years, which made only the Associate Membership possible. I feel now that I am nearer the goal of doing all that I would like to do for the American Museum of Natural History.

My visits to the Museum have been many; all of the visits have been interesting and mentally stimulating.

Natural History Magazine has relieved the hunger of a nature-starved city dweller. Words from me are not necessary to describe such a fine publication; it speaks for itself.

I hope this world-spread chaos will interfere as little as possible with your great work, which will outlive the memory of any war.

John A. Lundin.

Brooklyn, N. Y.

* * *

Sirs:

The article, "Quinine," in your September issue is very interesting. I note, however, what appears to be an erroneous date, resulting apparently from the interchange of two figures.

The text reads: "[cinchona] . . . remained botanically unidentified until 1753, when the French Government sent a scientific expedition to South America." I believe the year of that expedition was 1735. The *Britannica* says that Jussieu, who accompanied it, ". . . remained in South America for 36 years, returning to France in 1771,"—instead of remaining fifteen years, as you have it. The earlier date is also implied in Clairaut's *Théorie de la Figure de la Terre,* published in 1743. . . .

Charles W. Comstock.

Jackson Heights, L. I., N. Y.

The history of quinine contains numerous conflicting statements, but in this instance, as Doctor Comstock points out, the correct date seems to be 1735, the error presumably having originated through the transposition of two figures.—*Ed.*

NOTICE

READERS are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

* * *

Sirs:

Since we began to receive Natural History Magazine last year we have been very proud of our new membership in the Museum and look forward eagerly to each issue. The quality of the illustrations, particularly the beautiful cover photographs, and the variety of well-written articles are remarkable, and altogether we consider this the most indispensable of the periodicals which we receive.

We were interested especially in the panoramic view of the Goosenecks of the San Juan River which you published in your issue of last May. Because of the isolated location of this remarkable canyon, it probably is one of the least photographed of America's natural wonders, and we were surprised to see in print a picture that is almost a duplicate of our own—even to the arched effect caused by tilting the tripod canyonward.

The day after our picture was taken, which was two years ago, we began a seven-day journey by rowboat down the San Juan, through its desolate winding canyons, to the Colorado River and thence through spectacular Glen Canyon to Lees Ferry. Every mile of this water route through the desert is a new adventure, and although we negotiated every rapid safely, our trip almost ended prematurely in disaster by an impingement against a sheer sandstone cliff in the Great Bend.

The entire journey was an exhilarating experience and well worth the risks, and we were able to bring back a collection of photographs, in black-and-white and in color, of a country which has been seen by few white men. It is a gigantic colorful rock garden, but so inhospitable that it was shunned even by the Indians.

Thinking that your readers might like to know what the "Goosenecks" look like from the inside, we are enclosing a few photographs of that portion of the San Juan Canyons. The horizontal scene is a view of the point from which your picture was taken, and it shows the river at the place where parts 2 and 3 of the panorama are joined. The turbulence of the water in the other views is characteristic of the San Juan but cannot be seen from the rim of the canyon. The "ripples" visible in parts of your panorama are a type of current waves rising about five or six feet from trough to crest—just another example of the magnificence of the desert river canyons.

Mr. and Mrs. John E. Galley.

Wichita, Kans.

How the Goosenecks Look from Below

Views taken from a rowboat by Mr. and Mrs. John E. Galley, whose trip through the rapids between the Goosenecks and Lees Ferry on the Colorado is described in the letter opposite

THE SCENE at left is a view of the point from which the panorama above was photographed. It shows the river at the place where sections 2 and 3 of the panorama are joined

THE TURBULENCE of the water of the San Juan is not apparent from the rim. Ripples scarcely visible in the panorama are five- or six-foot waves

Continued from page 165

the thoughts that the birds and animals and fish suggested to him, and to these he added something of himself. When they were all linked together, they made very strong talk for the people . . . The carver did even more—he let his imaginings rise above the objects that he saw, and pictured supernatural beings too . . . You knew also by the totems what sort of man he was or at least what he should be because men tried to be like the creatures of their crest, fierce, or brave, or wise, or strong."

When the young artist first arrived among these Pacific Coast Indians of British Columbia, she was sized up critically. An old Indian Chief said laconically, "She has no fear, is not stuck up, and knows how to laugh,"—and she lived up to this evaluation all through the years. The Indians gave her the name *Klee Wyck,* meaning the Laughing One.

The author has not rushed into print; the stories which she began setting down when she was fifteen, are now published when she is three score and ten. The 21 short stories, which make up the book, are separate as paintings, but closely related to each other. They are intimate stories of the lives of these people, human experiences, many poignantly sad, but told with great beauty and understanding.

Te Ata.

BIOLOGICAL SYMPOSIA, VOLUME 8

- - - - - Edited by Robert Redfield

The Jaques Cattell Press, $2.50

IN this volume are assembled eleven papers dealing with various types of physiological and sociological integration.

Contributions by biologists and social scientists range from a discussion of the problems involved in the transition from unicellular to multicellular forms of life, written by Dr. Libbie H. Hyman, to a concluding treatment of integration in modern society, by Dr. Robert E. Park. The scope of the symposium is indicated by the titles of the other separate papers, which are as follows: "Intermediate Levels of Organismic Integration," Dr. J. William Buchanan; "Higher Levels of Integration," Dr. R. W. Gerard; "Synergistic Aspects of Bacterial Populations," Dr. William Burrows; "The Transition from the Individual to the Social Level," Dr. H. S. Jennings; "Integration in Intra-Social Insect Populations," Dr. Thomas Park; "Social Dominance and Subordination Among Vertebrates," Dr. W. C. Allee; "Basic Comparisons of Human and Insect Societies," Dr. Alfred E. Emerson; "Societies of Monkeys and Apes," Dr. C. R. Carpenter; and "The Societies of Primitive Man," Dr. A. L. Kroeber.

A comprehensive introduction by Dr. Robert Redfield includes detailed comments on each paper, together with a critical interpretation of the entire series. Despite the fact that the various treatments represent somewhat divergent scientific disciplines the volume as a whole is remarkably unified in its outlook.

Many of the chapters might prove difficult for the lay reader, but this collection of papers represents what is undoubtedly the most authoritative treatment of an extremely important topic. The organization is such that individual papers are complete and intelligible in themselves. The volume can be read piece-meal, allowing the reader to pick and choose as his interests dictate.

The symposium is an encouraging "sign of the scientific times." Leading thinkers in different fields of scientific endeavor are bringing their thoughts to bear on common problems of extreme social significance. This volume of papers amply proves the value of such a procedure, and justifies the prediction that the so-called "pure" sciences of today are fast becoming the applied sciences of tomorrow.

F. A. Beach.

GEOMORPHOLOGY

- - - - - - by Norman E. A. Hinds

Prentice-Hall Co., $5.00

GEOMORPHOLOGY is, as the name indicates, the study of the form of the earth, or more specifically, of the development of the surface relief of the earth. As such, it is the geologist's story of the origin of our landscape. To understand it one must know something of the rocks from which the landscape is formed, of the forces which build mountains and other surface features, and also of the agents of erosion which etch out the details of the world-wide picture.

Professor Hinds, a member of the faculty of the University of California, has presented here, in some detail, but in very readable style the essentials necessary to interpret the scenic picture, together with a multitude of specific examples illustrating the results of the inter-reaction of the various factors involved. The book is intended to serve as a textbook in the subject, but it should find a welcome place in the library of every lover of scenery, as well as of every amateur geologist.

No branch of geology offers greater possibility for the use of beautiful photographic illustration; the more than 500 examples here, mostly chosen from the wealth of material offered within our own scenic country, add much to an already valuable work.

H. E. Vokes.

ORNAMENTAL AMERICAN SHRUBS

- - - - by William R. Van Dersal

Oxford University Press, $4.00

HERE is an excellent book by one who writes with authority based on exhaustive study and wide experience. As a biologist of the United States Department of Agriculture, Dr. Van Dersal has traveled throughout the country working on problems of using plants for soil conservation. On these trips he gathered much of the material for this book.

In the first chapter he sketches the fascinating story of early plant hunting in the United States; how the earliest plant explorers sent their beautiful new discoveries back to Europe, while the pioneers, who settled in America, imported most of their garden and orchard plants from England, France, Spain, Germany, and Italy. Finally it became evident that the best of the native American plants were, as a rule, better for America than the imported ones, for reasons explained by the author.

The map of the United States is divided into 32 plant growth regions. Reference to these makes it easy to answer the important question whether or not a shrub will thrive in a certain area. There is a chapter on "Where Shrubs Can Be Grown," and another on "How To Grow Shrubs."

Out of some 1300 shrubs in this country, Dr. Van Dersal describes in groups the best of these for all parts of the United States, telling us what the grower wishes to know. In summing up, he lists the ten best shrubs each for the Northeast, the Southeast, the Northwest, the Southwest, and California, as well as the ten best shrubs of the United States. The leading shrub in this final list is the Flame Azalea of the Appalachians. Nearly 90 exquisite photographs add to the attractiveness of a book that wll be greatly appreciated by all who are interested in ornamental American shrubs.

Clyde Fisher.

WILD ANIMALS OF THE ROCKIES

- - - - by William Marshall Rush

Harper & Brothers, $3.00

THIS book is a collection of stories about game animals, bear, elk, moose, deer, antelope, buffalo, mountain sheep, and mountain goat, and the experiences of the author during his 22 years as a ranger in the Forest Service. The stories are grouped by subject matter rather than in temporal sequence, and the amount of space devoted to each varies. Mr. Rush has a sincere love for the animals of which he writes and for the wild country in which he worked. Those who know the Rockies and share his affection for them will enjoy reading the book and may develop a touch of nostalgia from it.

Little new is added to the available information on the life histories of the mammals written about here, but some facts are probably unfamiliar to the reading public, for instance the diseases of bear, deer, and sheep, and the attempts to treat the sick animals in the National Parks. The stories are frequently humorous, some of the description is of high quality, and the action is often vigorous. At times there is a tendency toward crediting animals with foresight and intelligence a little too human, but a great deal of experience with coyotes and bears leads many people to that conclusion.

Quite as interesting as the animal stories are the accounts, often inferential, of the work of the rangers. As guardian of wild life and the forests, investigator of the causes of decrease of game, firefighter, and administrator of the grazing privileges, the author had a wide experience, which he shares with the reader.

J. E. and H. L. Hill.

November **NATURAL HISTORY** *1942*

Solomon Islands · Devil's Tower · Animals of Africa

Story of Textiles · Animal Superstitions · Quartz

VOLUME L. No. 4 FIFTY CENTS

THE ANIMAL KINGDOM

ANIMALS OF THE WORLD,
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with special contributions by many distinguished authorities.

Virtually every wild and domestic animal is described; in two sections, animals of America, and animals of other lands. Illustrated with numerous photographs, and sixteen color illustrations. An exceptional book.

NORTH AMERICAN BIG GAME, $7.50

compiled by the Committee on Records of North American Big Game, Alfred Ely, Chairman.

The most comprehensive book published on the subject; practical and scientific information on all horned and antlered game, bears, puma, jaguars, and walrus found in North America. Articles on game hunting, vanishing and extinct species, conservation, etc. Many illustrations.

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by Robert Snedigar $2.50

Contains much valuable information on the subject of small wild animals as pets—especially interesting to scout masters, camp directors, and nature students. Refreshing and entertaining reading; numerous photographs.

FADING TRAILS: the Story of Endangered American Wild Life $3.00

Prepared by a committee of the United States Department of the Interior; Dan Beard, Chairman.

A challenge to all Americans; the vivid story of the discovery, exploitation, and present status of American wild life—how some species are now gone forever, and what we should do *now* to save those species which are at present in danger of extinction.

FIELD BOOK OF NORTH AMERICAN MAMMALS, by H. E. Anthony $5.00

Written by the Curator of Mammalogy, American Museum of Natural History, this book presents in convenient pocket form a thorough résumé of every known mammal north of the Rio Grande. 32 color, and 200 black and white illustrations, with many locality maps.

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skunk
daschund sitting
daschund standing
longhorn steer
penguin
brontosaurus
stegosaurus
cat sitting up
cat lying down
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An unusual and thoroughly readable natural history, with chapters on many forms of animal life, including amoeba, sea life, insects, amphibia, dinosaurs, reptiles, birds, mammals, and aquatic mammals. Profusely illustrated with excellent photographs.

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LETTERS

SIRS:

The September issue of NATURAL HISTORY is outstanding from a layout point of view—as usual—and was unusually interesting to me in the variety of its contents. I always study the layout of NATURAL HISTORY from cover to cover; you often have superb photos, but even when you don't, you do such interesting things with even the snapshots that the results look lively.

MARY LOUISE FAGG.
Washington, D. C.

SIRS:

As for NATURAL HISTORY, it is one of the best and most interesting magazines I know of dealing with the various phases of nature. I read each issue from cover to cover.

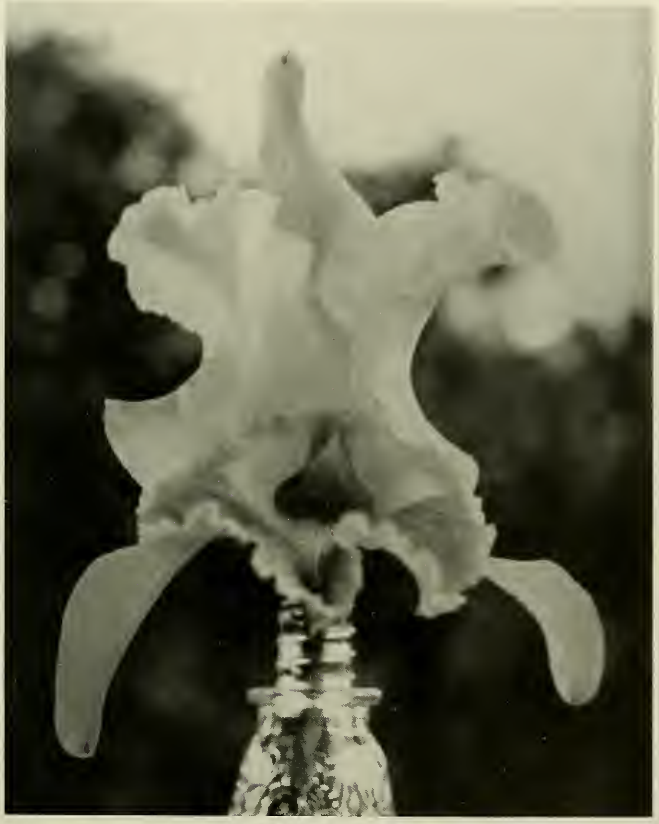
EVAN RANDOLPH.
Philadelphia, Pa.

* * *

SIRS:

. . . Superb article on Drum Talk; only explanation on this subject I have ever seen that really explained it.

M. D. FOLLIS.
Dunedin, Fla.



A tiny cocker spaniel puppy looks out from the heart of this multicolored South American orchid

SIRS:

Your article in the June issue of NATURAL HISTORY on wild orchids has impelled me to submit the accompanying photograph for possible use on your "Letters" page.

The South American orchid *Cattleya labiata* is one of the showiest and most popular of the 40 or more species of *Cattleya* orchids indigenous to continental tropical America.

The blooms of this epiphytic orchid are multicolored, about six inches across, and spread a rich fragrance. The most interesting thing about these plants to me, however—as a lover of dogs—is the miniature cocker spaniel puppy that peeps from the throat of each bloom!

MAURICE BROUN.

Hawk Mountain Sanctuary,
Orwigsburg, Pa.

Continued on page 220

LONGINES
the most honored watch for a Lady

A Longines Watch for a lady is much more than a charming jewel-like ornament. Within the beautifully wrought case is the Longines "Observatory Movement", a work of incredible precision, and unbelievable accuracy and dependability considering its tiny size. The photos of the Longines Watch and movement above are both greatly enlarged. The watch is one of several in the smart round design.*

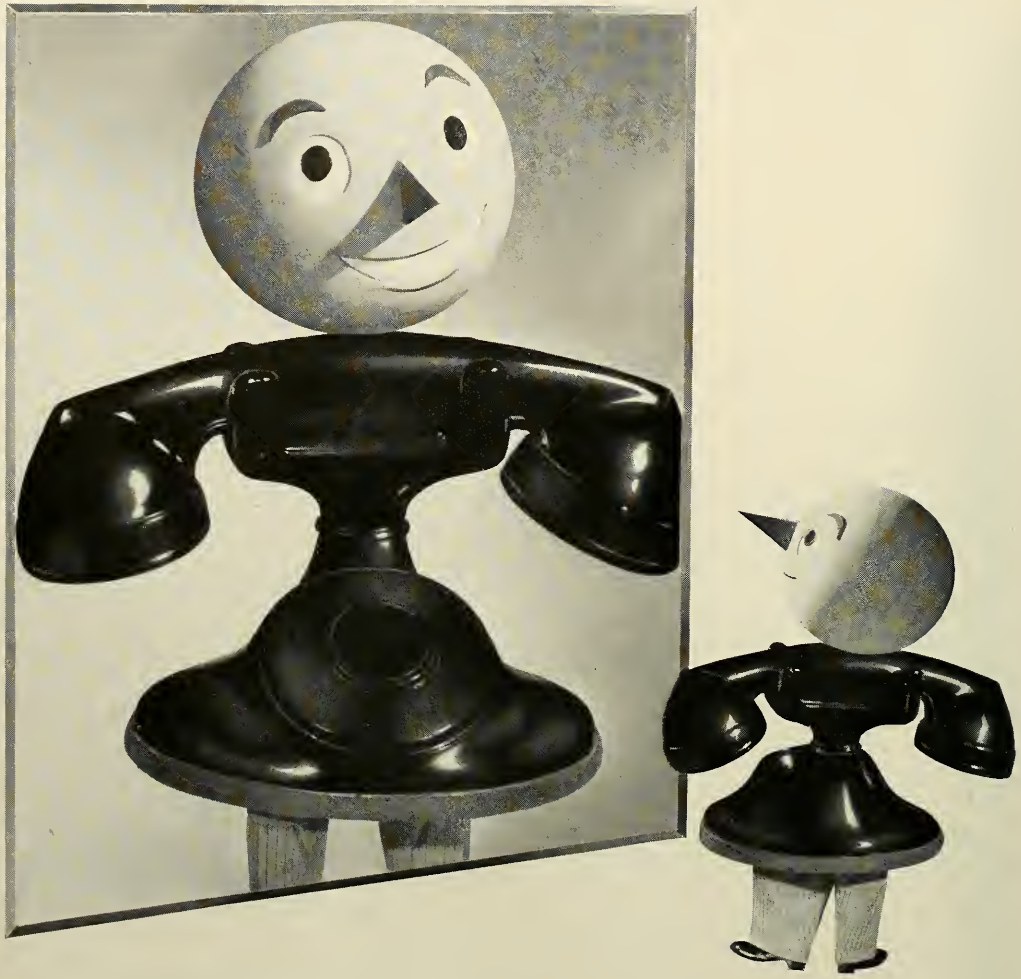
Longines

THE WORLD'S MOST HONORED WATCH

The established prestige of Longines Watches has resulted in a demand today greater than necessarily restricted production. Your Longines jeweler will show you the Longines Watches that are available, and all have the dependable Longines "Observatory Movement." Longines Watches have won ten world's fair grand prizes, 28 gold medals and more honors for accuracy than any other timepiece. See also the Wittnauer watch, a companion line outstanding for value at a moderate price—product of Longines-Wittnauer Watch Co., New York, Montreal, Geneva.*

*Trade Mark Registered U. S. Pat. Off.

Longines Watches have won 10 world's fair grand prizes, 28 gold medals



"If I were twice as big"

"Then I could give the public all the service it wants and take care of the war on top of that.

"But I can't get bigger now because materials are needed for shooting. So I'm asking your help to make the most of what we have.

"Please don't make Long Distance calls to centers of war activity unless they are vital. Leave the wires clear for war traffic."

BELL TELEPHONE SYSTEM

NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President ALBERT E. PARR, Director

VOLUME L—No. 4 ★ ★ ★ ★ ★ ★ NOVEMBER, 1942

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THE SOLOMON

By DOUGLAS L. OLIVER

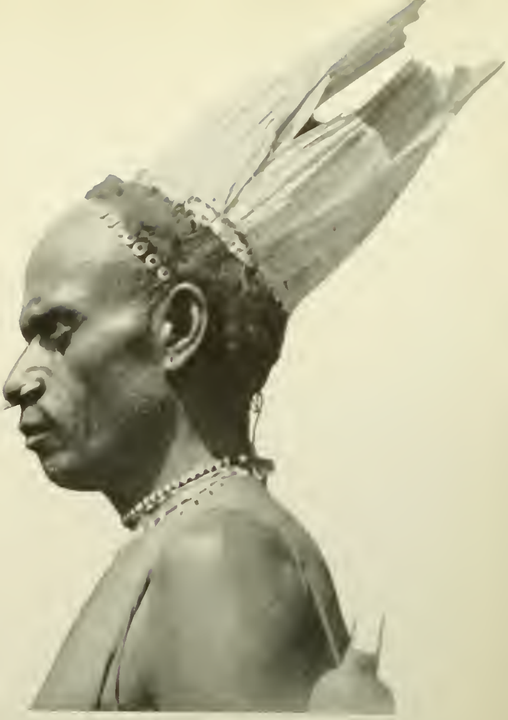
All photographs by the author, from Three Lions

▼ THE SOUTHERN COAST of the largest island in the Solomons: Bougainville. The bungalow at extreme left is the Government outpost for the whole southern part of the island. At this outpost, called Kangu, an Australian patrol officer was stationed, who kept the census records, collected the head tax, and heard court cases among the natives. A Roman Catholic Marist Mission was located near where the white launch is anchored. The missionaries used to travel about the interior making converts and administering to the health of the natives

ISLANDS

A sixteen-month expedition to the "Black Spot" of the South Pacific sheds light on a region now occupied by the Japanese

➤ A NOSE SKEWER and necklaces of clam shell disks and dogs' teeth are cherished ornaments of this Solomon Islander. His partly completed coconut leaf hat will be worn only on festive occasions. Trade-store buttons decorate his forehead



BECAUSE they are among the least known and most primitive people in the world, the Solomon Islanders are a dramatic illustration of the way in which the war has plunged obscure corners of the earth into sudden contact with the most elaborate developments of mechanized civilization. The accompanying photographs, taken in 1938 and 1939 during an anthropological investigation in Bougainville Island for the Peabody Museum of Harvard, show several important aspects of the primitive life of these people, little changed by civilization. Since then, many a bone-pointed spear has doubtless lodged in the back of a Japanese invader; and the purely native way of life may never again be seen here.

Bougainville, 125 miles long, is the largest island in the Solomon group and is mountainous, with marshy stretches along its outskirts. Lying northwest of Tulagi, Guadalcanal, and other points that have recently been the scene of violent fighting, it may be a main center of operations in the battle for the southwestern Pacific.

The Solomon Islands were named after King Solomon because of the natural riches they were believed to contain by the Spanish navigator Alvaro Mendaña, who is credited with their discovery in 1567. Indeed, because of this anticipated wealth, the Spaniards kept Mendaña's narrative a secret. Poor navigation and imperfect mapping contributed further to the delay, and it was two full centuries before the islands felt the impact of European contact. Actually the products of the islands are chiefly copra, tortoise shell, sandalwood, nuts, fruit, coffee, and cacao. But the natives, reckoning wealth in their own terms, attach more importance to the prestige gained through it than almost any other primitive people.

This ambition to achieve political and social prestige through wealth permeates their whole social life.

To acquire this *potu,* as they call it, the inhabitant of the interior of Bougainville accumulates all the shell money he can. The aim is not wealth for the sake of security or to assure a comfortable future for his family, nor is it the accumulation of riches for their own sake. The real aim is to excel in a rather grim form of competitive generosity. The native will mobilize all his property and that of his family just to throw one big party at which he means to outdo his political rival. If the rival, in turn, wants to bid higher in the political race, he must invite his host to an even more sumptuous affair.

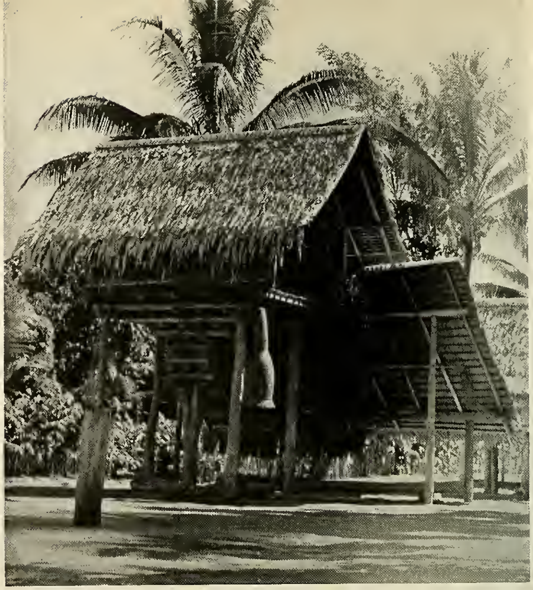
The same desire for wealth and prestige shows in all the ceremonies in the natives' lives. Weddings are climaxed by ardent prayers for wealth and *potu,* and so are births, funerals, and other functions. The Solomon Islands have not produced the worldly treasures that are associated with their Biblical namesake, but their inhabitants are thus found to have built up a social code that gives fantastic expression to the glory of wealth.

The name "Black Spot" has become attached to Bougainville and a few smaller islands in the Solomon group, because of the blackness of the natives as distinguished from the brown-skinned people on New Guinea and elsewhere in the region. The negroids of Bougainville live a primitive agricultural life that is markedly different from that of most of the numerous oceanic peoples that are dispersed widely over the South Pacific and are known as Austronesians. Even as close as along Bougainville's own coastal strip, Austronesian people have encroached to become the "sophisticated" neighbors of these seclusive negroids.

On Bougainville there are some 30,000 natives. Aside from raising pigs, the men spend their time mostly in smoking and chewing betel, while carrying on endless political discussions. The women raise crops of taro, Bougainville's staple food, as well as coconuts, almond, and breadfruit. The men also fish in the streams with bow and arrow, but they never reach any appreciable degree of efficiency as fishermen or hunters.

The history of the Solomons, from the time when traders and missionaries endeavored to settle in the islands approximately a century ago, has not been peaceful. Murder and plunder have cast their shadow across the archipelago. About the middle of the last century Benjamin Boyd, while cruising in the yacht "Wanderer," was kidnapped by the natives and never heard of again. In 1899 a demarcation between German and British influence in the islands was established. But the German Solomons, in which Bougainville was included, were occupied by an Australian force in 1914, and the islands were assigned to Australia in 1920 under mandate from the League of Nations. Even as late as 1927 an outbreak of the natives resulted in the death of several persons and necessitated martial law.

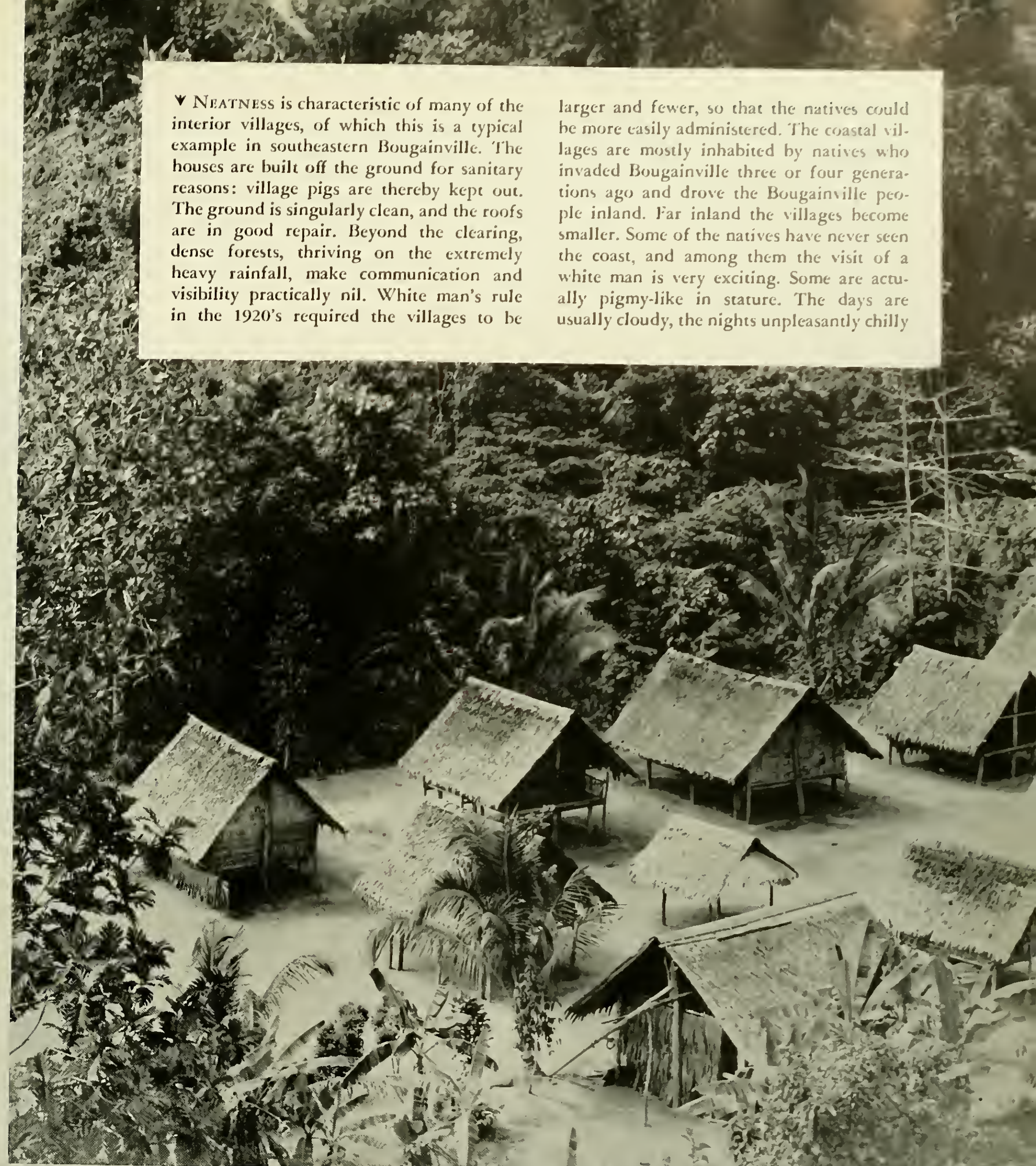
The plight of the Solomon Islanders at a focal point in the battle of the Pacific is an unhappy one. It is to be hoped that in the post-war world they will return to a more secure and constructive life than is now their lot.



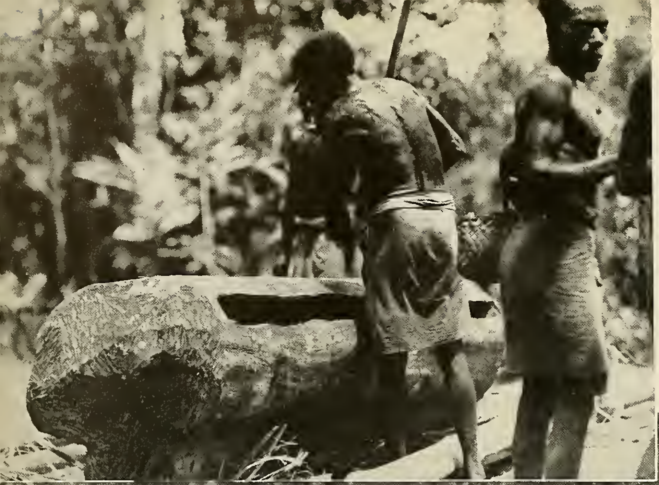
▲ Tree house in an inland village. Some houses of this type are actually built for protection against head hunters. Sleeping is done in the house itself, most of the cooking, eating, and gossiping under the adjacent shed. The basket-like object is a fish trap of a kind common throughout most of Melanesia

▼ The natives have been required to keep their roads constantly improved to enable the officials to travel long distances on bicycles. Village chiefs, competing in the beautification of their road, sometimes widened them excessively, making highways broad enough for 40 men to walk abreast. Yet the natives themselves always walked down them single file

▼ NEATNESS is characteristic of many of the interior villages, of which this is a typical example in southeastern Bougainville. The houses are built off the ground for sanitary reasons: village pigs are thereby kept out. The ground is singularly clean, and the roofs are in good repair. Beyond the clearing, dense forests, thriving on the extremely heavy rainfall, make communication and visibility practically nil. White man's rule in the 1920's required the villages to be larger and fewer, so that the natives could be more easily administered. The coastal villages are mostly inhabited by natives who invaded Bougainville three or four generations ago and drove the Bougainville people inland. Far inland the villages become smaller. Some of the natives have never seen the coast, and among them the visit of a white man is very exciting. Some are actually pigmy-like in stature. The days are usually cloudy, the nights unpleasantly chilly

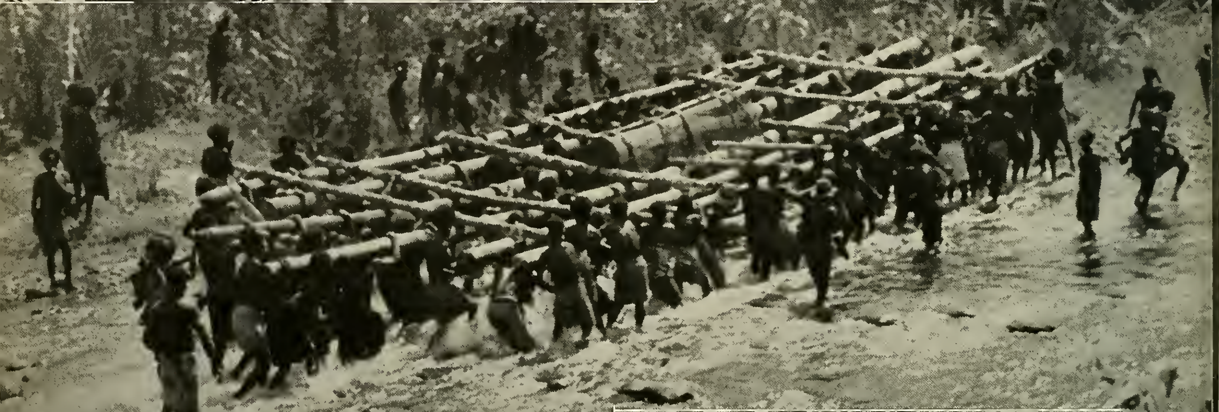


◀ AN OUTRIGGER DUGOUT in Kieta Harbor, the chief administrative and commercial center of Bougainville. Kieta Harbor can accommodate almost any size of ship and offers access to the interior by several mountain trails. Before the Japanese took over, it had a white population of about 30 and a small Chinese merchant population

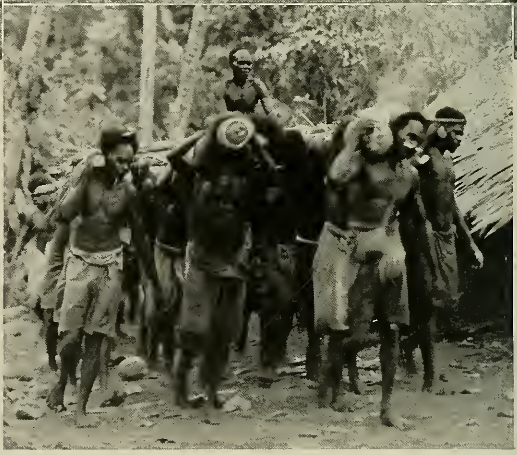


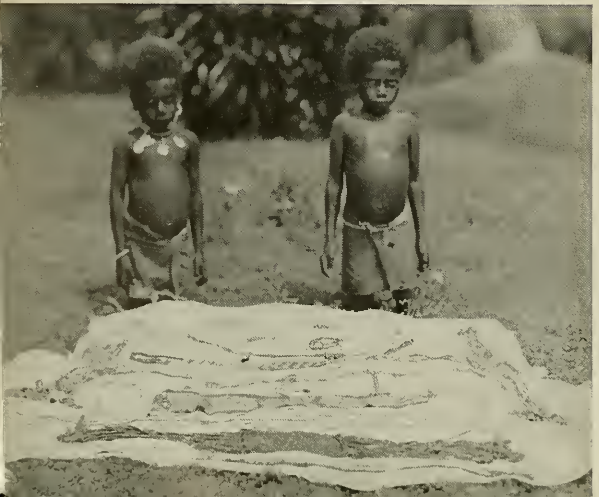
◄ A Passion for prestige goads every man to own as many wooden gongs as he can, for they indicate prosperity. The man who owns the most and whose gongs are most often beaten will be most widely known. The drums are installed in men's clubhouses, which women are forbidden to enter

▼ The heavier the gong, the more men needed to carry it. The more men, the larger the outlay of food at the feast. The more food that is distributed, the greater will become the fame of the host. Therefore, it behooves the ambitious man to install as many large gongs as possible in his clubhouse

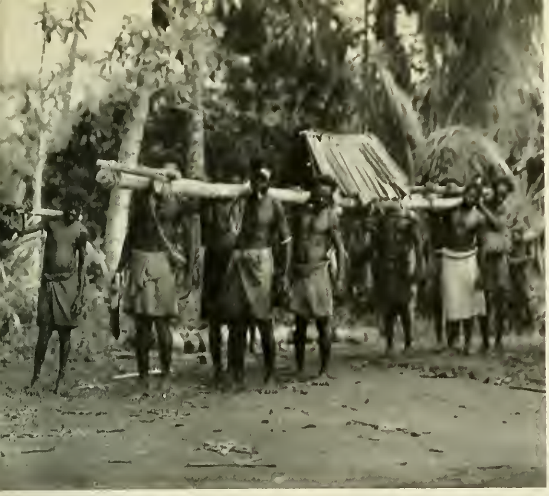


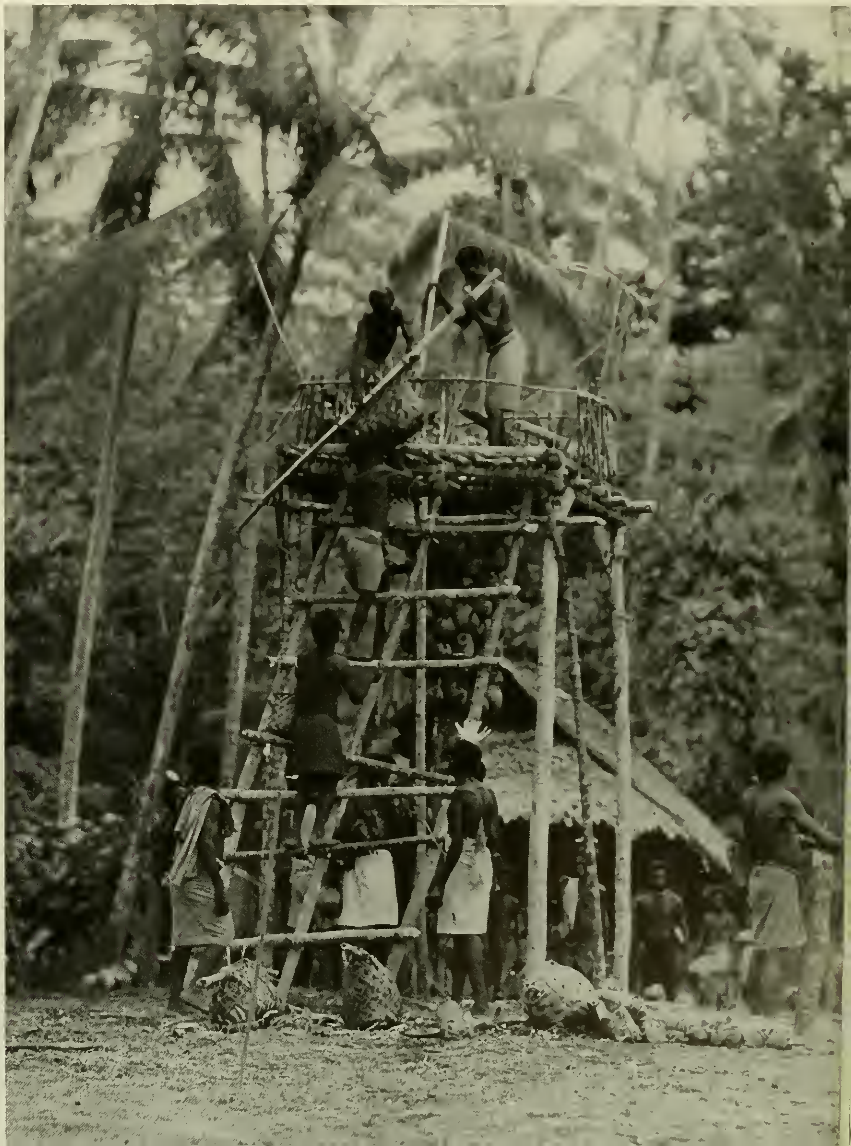
► Sometimes the owner will cause his invisible guardian demon to sit astride the gong to increase its weight and require the carriers to work harder. "What a heavy gong!" the people will then say. "What a wonderful man our host must be!" When the carriers become over-weary, however, they may place one of their own magicians on top of the gong, as shown here, to drive away the demon and lighten the load





◄ Shell money is the first necessity on the road to personal prestige in Bougainville's little known "Black Spot," but ownership of the money itself does not bring distinction. A man must distribute his wealth in the form of feasts. The natives themselves, however, do not make the shell necklaces and belts like those shown in this picture. They are manufactured of clam and mussel shells by coastal dwellers and are traded for pigs, weapons, and vegetables

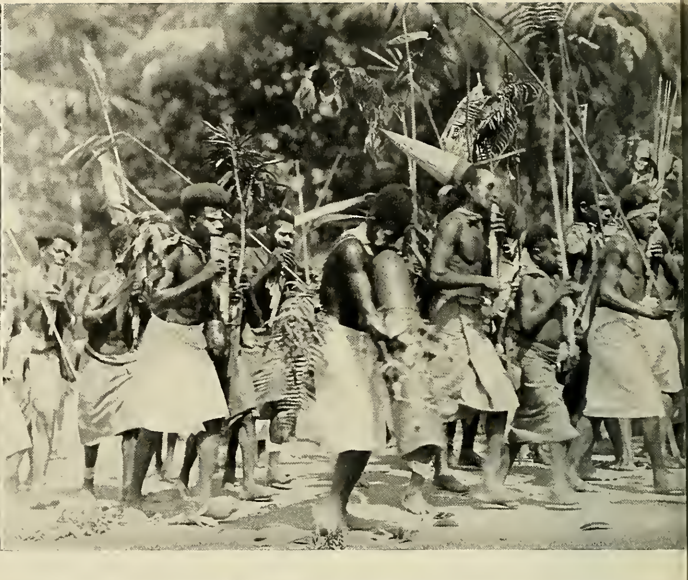




▲ WITH THE ACCUMULATED SHELL MONEY the native buys pigs, so he can invite his rival to a generous feast that will show how opulent he is. The pigs in the village are not allowed to scavenge but are fed carefully cooked taro and yams. Here a large pig is being carried in from the forest to the village of the feast giver, protected from the sun under a palm leaf shelter

(Top, right) PLAYING GROWN-UP. So important among these people is the feast to gain prestige that even the children are imbued with the spirit and pretend to carry pigs to a feast as shown here

➤ AFTER ENOUGH pigs have been accumulated, the host constructs a display platform as shown at right and decorates it with food dainties —coconuts, taro puddings, etc. Anyone seeing so much food on display will naturally exclaim, "What a wealthy man he must be!"



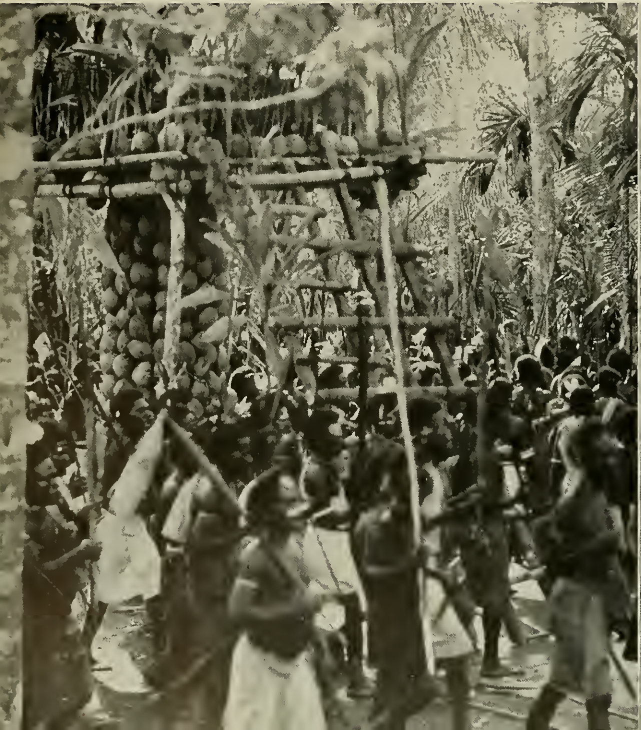
▲ For days before the feast, the natives dance and sing in dress rehearsal, praising the virtues of their host. Then they dance toward his clubhouse, and the ceremony is on

▲ Flutes and pan pipes of all sizes and tones are played, but the most spectacular instrument is the large wooden trumpet being blown by the man in the center. It sounds not unlike a tuba. The total effect resembles a Brahms woodwind movement more than anything else in European music. Dancing can go on for eighteen hours without let-up

---

▼ In the final dance scene, the dancers circle the food display platform, which they will soon storm in an effort to get at the best tidbits

▼ After the feast the host distributes live pigs, one of which is seen here, among the followers of the guest of honor. A careful record is kept of the number of pigs The worried faces of the natives signify that they feel it may be no small task to accumulate the equivalent for a reciprocal feast



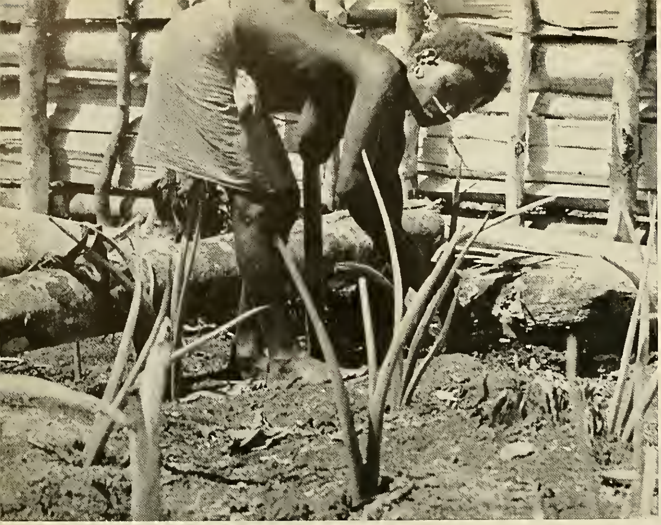
▲ THE HEAD HUNTING DAYS are remembered by most of the natives, who use every opportunity to demonstrate their skill with spear, bow and arrow, and battle axe. Here a mimic battle is being staged

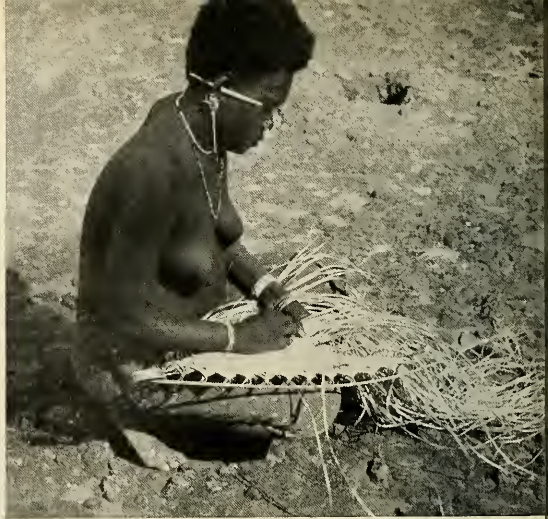
▲ HOSTILITY between host and guest is an undercurrent during the feast, for invitation is something of an insult, being a challenge to make a bigger display of generosity. Here the friends of the guest of honor, far from admitting complete deference, are staging a mock attack on the host's clubhouse

---

▼ A VERY OLD MAN grinding arica nut and lime, the familiar betel nut mixture which is chewed as a stimulant by all the natives

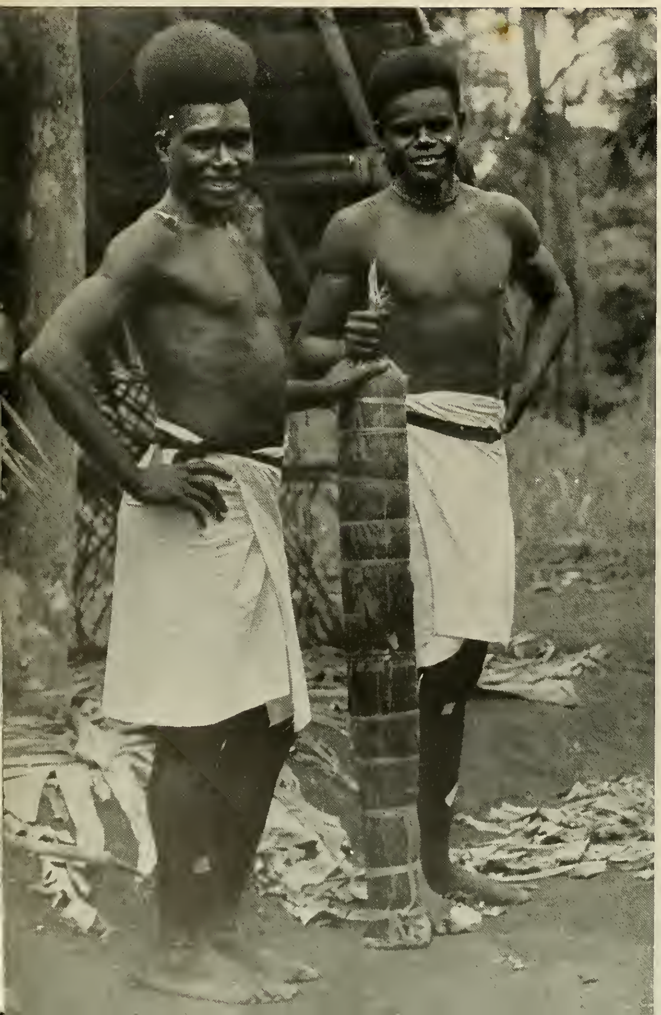
▼ A SOLOMON ISLAND YOUTH playing on a small flute of a type that is not native here but was copied from models from New Guinea





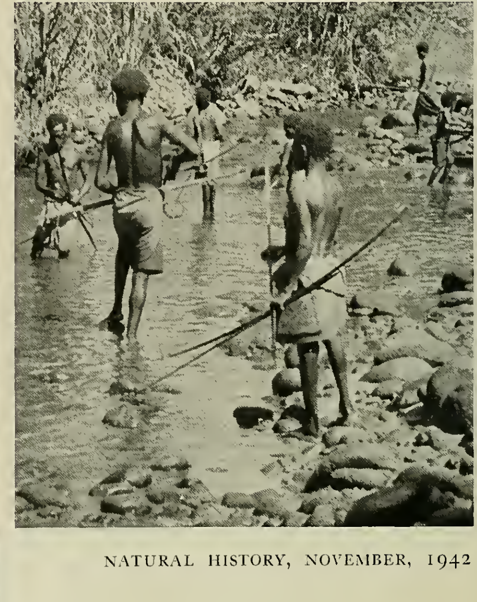
▲ THE TARO PLANT constitutes about 90% of the food consumed on Bougainville. This woman is planting the stalks in a hole made with a digging stick. The root tastes like a cross between an Irish potato and a turnip. The strong fence is to keep out hungry pigs

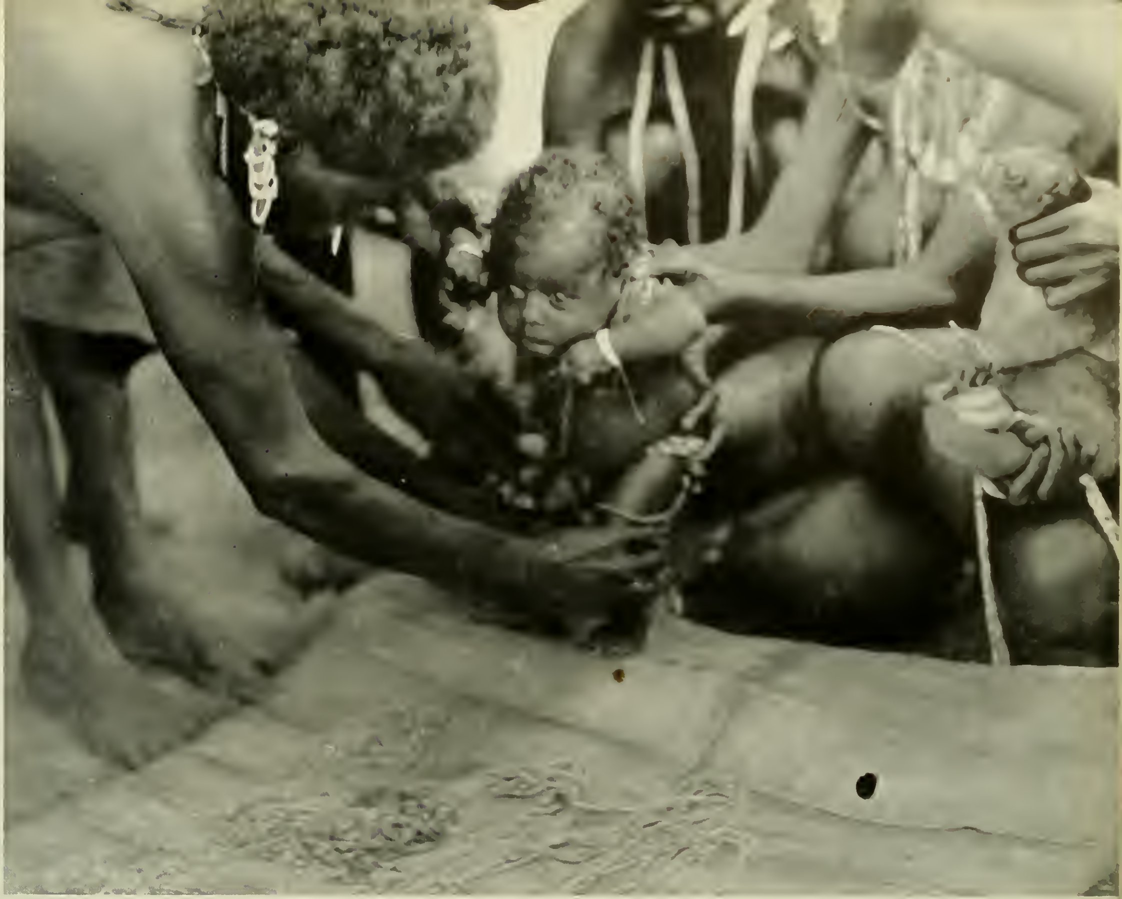
▲ AN INLAND WOMAN of the Solomon Islands weaving a basket of palm leaf fibers. These natives were still living in the stone age when first contacted by whites a few years ago



◄ SAGO, a dry granular starch, is prepared from the pith of the sago palm as a supplementary food. The pith is shredded with wooden mallets, and the starch separated from it by soaking. Sago settles to the bottom and is taken out and packed in leaf containers like the one shown here. The container is dried over a fire and packed away in the rafters for future use

▼ FISHING WITH BOW-AND-ARROW AND SPEAR, after having diverted water from a stream by damming. The inlanders are primarily farmers and do not distinguish themselves as fishermen or hunters

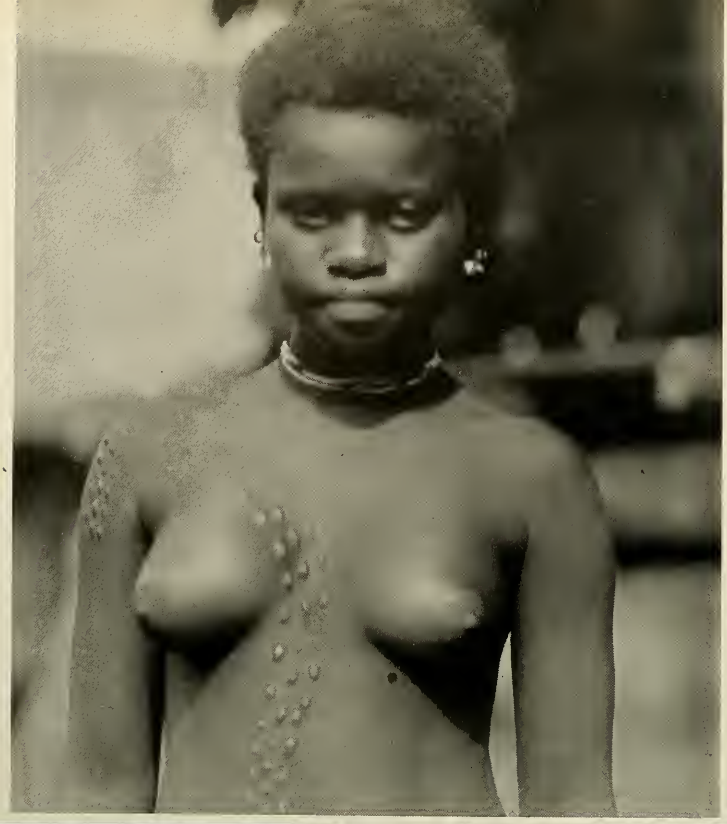




▲ CHRISTENING CEREMONY. Coconut water is sprinkled over the child and a magic formula repeated imploring the ancestral spirits to make it strong and wealthy. Then the infant is made to walk over quantities of shell money and other valuables, as shown here. Both the infant and its mother are covered with shell necklaces, a sign of the wealth of the family. The opossum at right is a scapegoat which it is hoped the jealous and malicious spirits will mistake for the child in case they are inclined to vent any ill will. It is later sacrificed

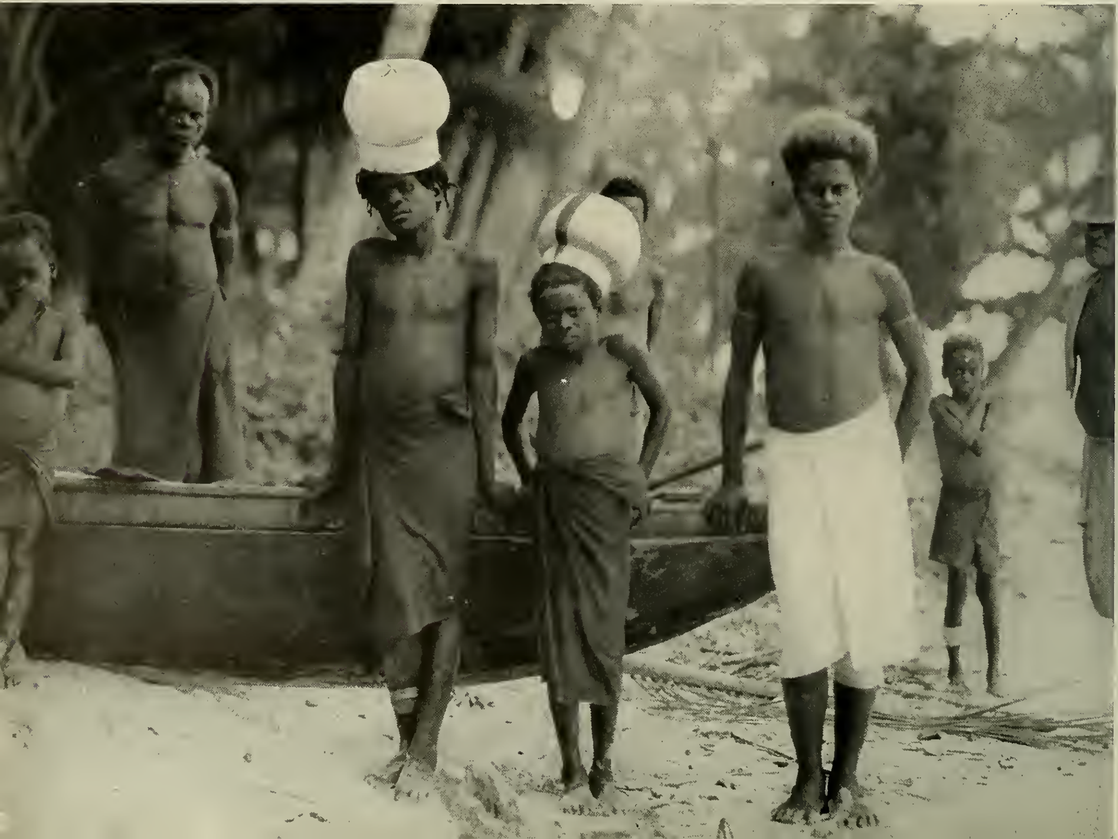
▼ A CHRISTENING CEREMONY is a good excuse for a dance, celebrated by the women alone. The calico that they wear here is from the traders; the short Mother Hubbards were furnished by missionaries. A few years ago the natives wore only a brief fiber apron and loin cloth

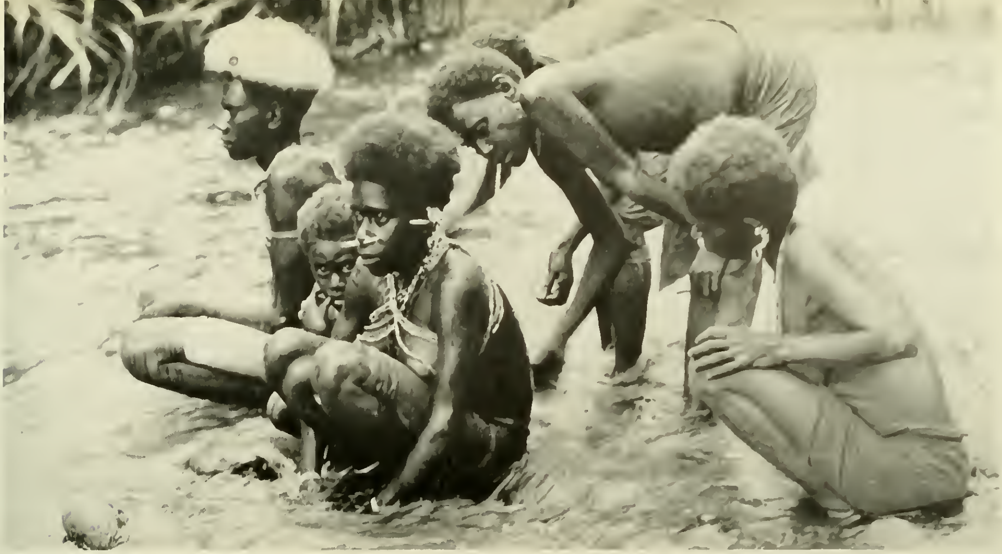
▼ YOUNG AND OLD show the energy of youth when there is a christening dance. The women have amazing vitality and work hard



◄ TATOOING would not show on their dark skin; therefore the negroids of Bougainville produce scars by burning or cutting and rubbing dirt or ashes into the wound

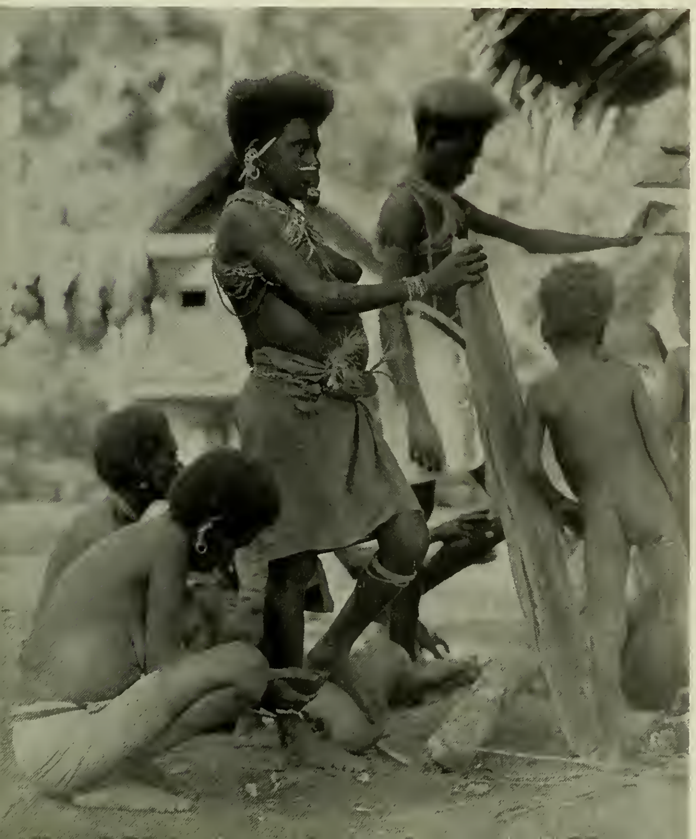
▼ ADOLESCENT BOYS wearing the hats they must never remove before women for several years. Any female who saw a youth without his hat would be instantly killed in the days before European control. The hair eventually fills the whole space. Then, when the father can afford a feast, the lad is initiated into the secret rites of full manhood and is considered mature. He can then set about finding a wife for himself





▲ **MARRIAGE CEREMONY.** In the first episode, the groom (with "peroxided" hair) squats in a stream beside his bride, with a young bridesmaid in between. Three priestesses scoop water over the three, supplicating the ancestral spirits to give the young couple wealth and health. Enterprising Chinese traders have now begun to sell the natives real peroxide to replace the lime used in hair bleaching

▼ **THE BRIDE AND GROOM** then stand by their house with one foot on a coconut, while priestesses anoint them with coconut oil in which magic ingredients have been placed. This, too, brings wealth and long life. Thereafter the young couple retire to the house and ritually eat a piece of pork. The marriage is thereby considered consecrated



▲ **LIGHTING UP.** Women smoke even more continually than men among these inland people of the Solomons. Their pipes are bought from trade stores and almost never leave their mouths. Green leaves of tobacco are ripped from the home-grown plants, waved over a fire, and stuffed into the pipe. Sun-curing is rare, as indeed is the sun itself in the rainy mountains of the Solomons

ИНДІЯ
ЦЕНТР
АМЕРИКА
ЮЖН. АМЕРИКА
БРАЗИЛІЯ
ЕАНЪ

STRATEGIC MINERALS

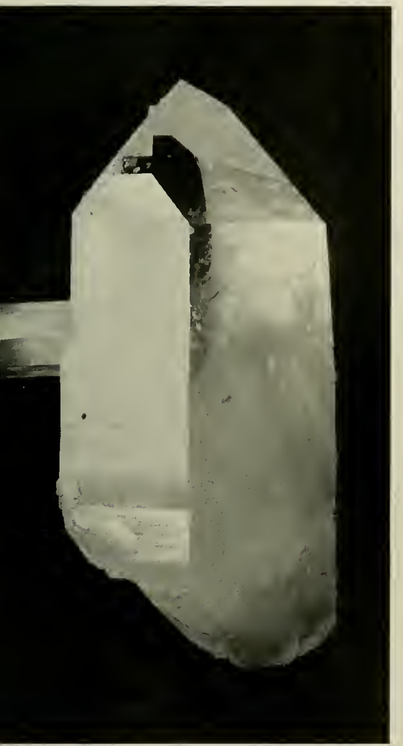
NUMBER IX

QUARTZ

◄ A Globe of cut crystal calls attention to the one vital source, Brazil

It is found almost everywhere and it enables man to defy space, but the pure crystals essential in *blitz* warfare all come from one country

AMNH photos by Cales



▲ Quartz crystallizes in the form of six-sided prisms, terminating in steeply inclined planes. These end planes do not have full symmetry but are grouped in two sets of three planes each, and their different nature must be considered in cutting quartz for use in radio

By Frederick H. Pough

Chairman and Acting Curator,
Geology and Mineralogy,
The American Museum of Natural History

Little drops of water
  Little grains of sand
Make the mighty ocean
  And the pleasant land.

Although the familiar rhyme isn't completely true, it does no serious violence to the scientist's feelings to say that little grains of sand make up the earth, and since most of the sand in the world is quartz, it is clear that quartz is one of the commonest of all minerals. It has been known to all peoples through all ages, under a multitude of names. For it has certain properties, obvious ones, which have made it a valuable material to all civilizations.

Its place on our strategic list, however, is not the result of any of its older uses. The modern use of quartz is totally new, and quartz is the only mineral that is strategic in this war but was of little importance in the last. A *blitzkrieg* would be literally impossible without it.

This is largely because of the use of quartz in radio instruments—a use discovered only 22 years ago. Today all radio sending sets, and some receivers, contain thin plates of quartz. These make it possible for many stations to operate simultaneously whereas only a few could before. When, for instance, you turn your radio dial to WOR, you always find it at 710, not wandering around somewhere between 700 and 720. The quartz crystal enables the sending station to stay precisely on its wave length or frequency, and thus many stations can be crowded into the air without overlapping. Today there are 900, as against 20 in 1922.

This sharp control of radio frequencies is vital in war actions, where many tanks, planes, and ships must remain in constant communication.

Chemically, quartz is one of the simplest minerals. It is silicon dioxide. By reason of its molecular structure, it is now classed with the silicates and thus belongs to a large group including about one-fourth of the known minerals. The silicate minerals are the principal rock-making minerals, and quartz is an important one of them. Since it is not always present in igneous rocks, it has been made one of the minerals upon which their subdivision is based.

The problem of locating strategic supplies of quartz is simplified by the fact that it is impossible for quartz to occur with certain other minerals. Where you find olivine, for instance, you will not find quartz, because olivine presupposes insufficient excess silica. Readers will recall that a somewhat similar process of elimination was possible in the case of mercury, based on the age of the rocks and the length of time that had elapsed since volcanic activity occurred in the region. In the search for minerals, negative advice from the geologist is of course just as valuable in terms of time and money as is positive.

Quartz can form in all the classes of rocks—igneous, sedimentary, and metamorphic—, but it is originally an igneous mineral. It forms when deep-seated rocks crystallize after all the other ingredients, such as magnesia, iron, and alumina, have satisfied their silica needs and formed stable compounds. We also get quartz if the still liquid portion of a crystallizing magma is drawn off before all the reactions take place, leaving a final excess of silica which would otherwise have been used up in more complex combinations. This is the present theory of the formation of granitic rocks and is the reason why some minerals cannot occur in the same rock with quartz.

The kind of quartz, however, that is a constituent of granite, while very common, is quite worthless. The strategic variety of quartz is rock crystal, flawless, colorless, and of good size. But even the purest, most perfect looking piece of crystal may still be worthless for radio equipment.

Quartz crystallizes in six-sided prismatic crystals, terminated by six steeply inclined planes which are known as rhombohedrons. These six terminal planes are not all alike, as in beryl, for example, but constitute two sets of three planes each; hence quartz is said not to have full hexagonal symmetry. These two sets of planes are called positive and negative rhombohedrons, and they are important in the radio use of quartz. In addition, quartz crystals sometimes have additional sets of planes, somewhat skewed to the right or left of the ridge between the rhombohedrons, and these determine whether the crystal is what we call left-handed or right-handed. All quartz crystals are one or the other, or both in intergrown combinations, but their nature cannot easily be determined if this third series of faces is not present.

In modern times as in ancient, one of the characteristics of quartz that makes it useful is its hardness and, in the broader sense, its stability under many sorts of conditions. Its hardness is 7 on the mineral scale of hardnesses ranging from 1 to 10, and that is harder than the best grades of ordinary steel, which reach about 6. It does not cleave readily and is a tough mineral under impact. Quartz also resists acids: only hydrofluoric attacks it at an appreciable rate. It cannot oxidize since it is already a stable oxide; and since it does not combine readily with water, it survives the attacks of ordinary atmospheric weathering. The sands of our beaches are good evidence of the hardihood of this mineral, for they are the quartz that has remained in relatively pure form after the other ingredients of the rock have weathered away. The stable quartz fragments remain on the beach, while the feldspars and dark minerals composing the original granites have turned to clays and muds and been washed away into the sea.

One might think that so resistant and clear a mineral would make a good gem, and it does with a single drawback—it is too common ever to be very valuable. There are many gem varieties: rock crystal, citrine, amethyst, and rose quartz, to name a few, and one could go on for half a page. In ancient times it was not realized that clear rock crystal quartz was the same as some of the opaque or translucent varieties like agate, chalcedony, carnelian, and jasper, for these were formed in a different way and look very dissimilar. Instead of being produced from the molten magma about which we spoke earlier, these were formed from aqueous solutions and are very finely, in fact microscopically, crystalline. Much of the silica composing them came from the decomposition of silicate minerals like feldspar, substances which appear to yield their silica into solution more readily than does the primary quartz.

The Greeks and Romans were, therefore, a little hazy about the true nature of some of their gems. They knew rock crystal and called it *crystallus,* in allusion to their belief that it was formed in the Alps from water which was frozen so hard that it could never melt again. Since color was an important distinction to them, they naturally did not associate amethyst, crystal, agate, and jasper as we do today. The general name, quartz, was a miner's word in the Middle Ages, mentioned in Basil Valentine's and Agricola's works.

Large colorless and flawless single crystals are in great demand today for use in radio oscillators. The property of quartz that makes it valuable in electricity was investigated by the Curies before their radium work and is known as piezo-electricity (from *piezin,* the Greek word for "to press"). This refers to the habit of the substance to develop an electrical charge upon application of pressure. Conversely, when subjected to alternating electrical current, quartz commences to vibrate, giving off current at the same time. The frequency of the vibration depends upon several factors: the orientation of the slice selected in the crystal and its proportions. However, for any single slice the frequency is very definite, never deviating from the fixed rate. Thus it can be used in a radio transmitter to fix the frequency of the vibrations and hence the wave length. Of course, the current generated by the single quartz slice is exceedingly small, but this is so amplified by oscillating vacuum tubes that the tiny fragile quartz is able to stabilize the frequency of the whole powerful transmitter.

Many other substances also exhibit this piezo-electric property—Rochelle salt, sugar, tourmaline, and others. Rochelle salt has a far stronger piezo-electric effect than quartz, and it is used in electric phonograph pickups. The vibrations of the needle cause the generation of an electric current in the Rochelle salt crystal. But this crystal is rather fragile and is sealed into a container in which it operates over a very limited range of temperature. Such pickups are far from sturdy, and radio transmitters in tanks and airplanes must stand considerable abuse and violent changes in temperature and humidity. Quartz is the only substance found so far which is satisfactory.

The cutting of these so-called "radio crystals" is a delicate job, for the frequency of the vibration will change with the removal of each molecular layer. Furthermore, in order to cut a slice that will retain a fixed frequency, it must be exactly oriented in the original crystal. Positive and negative rhombohedron faces must be identified, and the direction of the piezo-electric axes determined. An artificial face is then cut on the crystal at a definite angle to the Z-axis, an angle which must be within a quarter of a degree of the proper inclination. Slices of the flawless crystals are cut parallel to this layer, and they are then etched in hydrofluoric acid, which brings out a complex pattern if the crystal should be one of those complicated combinations of right- and left-handed crystals of which we spoke. If the slice, or a portion of it, is found to be usable, this is then shaped up to definite dimensions, and carefully ground smooth. The final slice is continually tested on an instrument which gives off a howl of varying tone as the slice is thinned down to the desired thickness and vibration frequency. When the instrument becomes silent, the crystal is ready. But so critical is the thickness that the brushing of a finger across the crystal can ruin it and start the howl again.

Several different cuts are used in making these crystals, either for different purposes or because of patents. Sometimes they are sliced singly, sometimes in groups by means of gang-saws. Again, a whole slab may be sliced in a single piece and later subdivided. But these small vibrating wafers are, of course, the final product. Vast quantities—millions—are needed. A single plane or tank may use a hundred or more to be in touch with other planes or tanks and with operational bases. With the vast number of mechanized units being produced today, it is not hard to visualize what a real problem it has become to get the necessary quartz and to turn it into the precisely made slices. In normal times only a few were needed, and a small cutter could turn out all that were required.

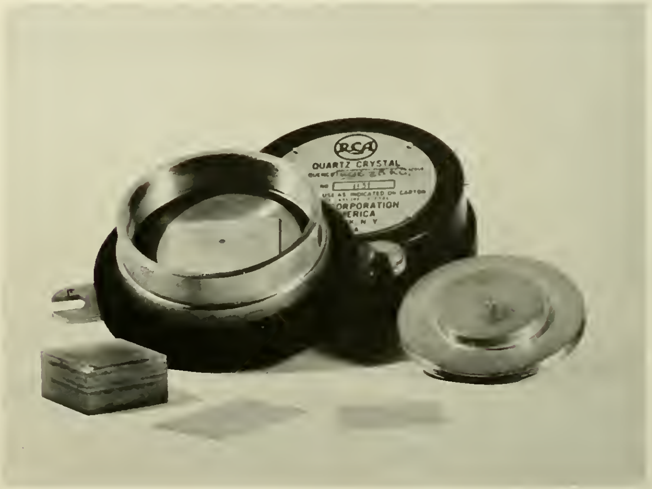
All of the quartz for these radio "crystals" comes from Brazil. It occurs in strongly weathered and decomposed veins which are related to the igneous activity in the region. The deposits are very ancient and probably were produced from solutions rich in silica which came off near the close of the magmatic activity. Some of the crystals are found still in place in the veins; others, having been washed down, lie in boulder beds.

The United States has agreed to buy all that Brazil produces, but even this may not be enough. Prices vary according to size and quality, from $1 or $2 per pound up to $15 or $30. Proportionally less is paid for crystals that are badly flawed or twinned (that is, composed of two or more crystals, or parts of crystals, in reverse position to each other) than for ones that permit easy orientation and the slicing of large, pure blocks of usable material.

Formerly much of Brazil's quartz went to Germany and Japan. Though most of this was of poor quality and was ostensibly imported for art carvings, much unquestionably leaked into war use. Today we are sure that none is getting to the Axis.

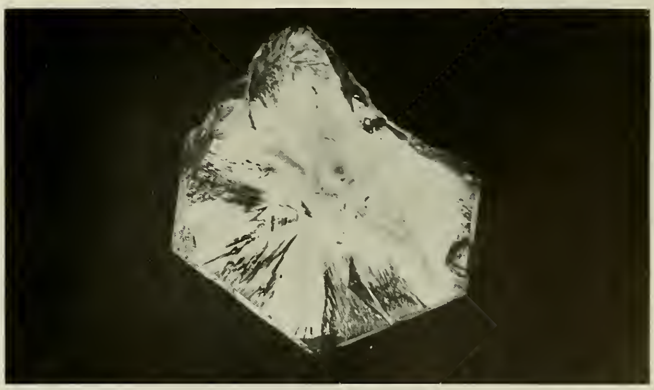
This country produces no quartz for electrical purposes, but there are thought to be possibilities in some of the Hot Springs, Arkansas, deposits; and the New York Herkimer County "diamonds" have even been considered. Sweden has recently reported deposits of good quality crystal but little seems to be known about them. The American deposits will probably be exploited only if a serious Brazilian shortage develops, for the crystals are smaller and will be more expensive to slice. It is further hoped that experiments which are now being carried on may lead to the successful production of suitable synthetic material, but the task may prove a difficult one.

▼ GROUND so precisely that the brush of a finger will ruin their radio frequency. Quartz "crystals" of this type make it possible for the many mechanized units in a modern battle to maintain contact with one another



AMNH photos by Coles

▼ AN APPARENTLY FLAWLESS crystal section is shown by polarized light to be complexly twinned and hence worthless for radio. Quartz is also used in depth-sounding instruments, ballistic apparatus, periscopes, and gun sights



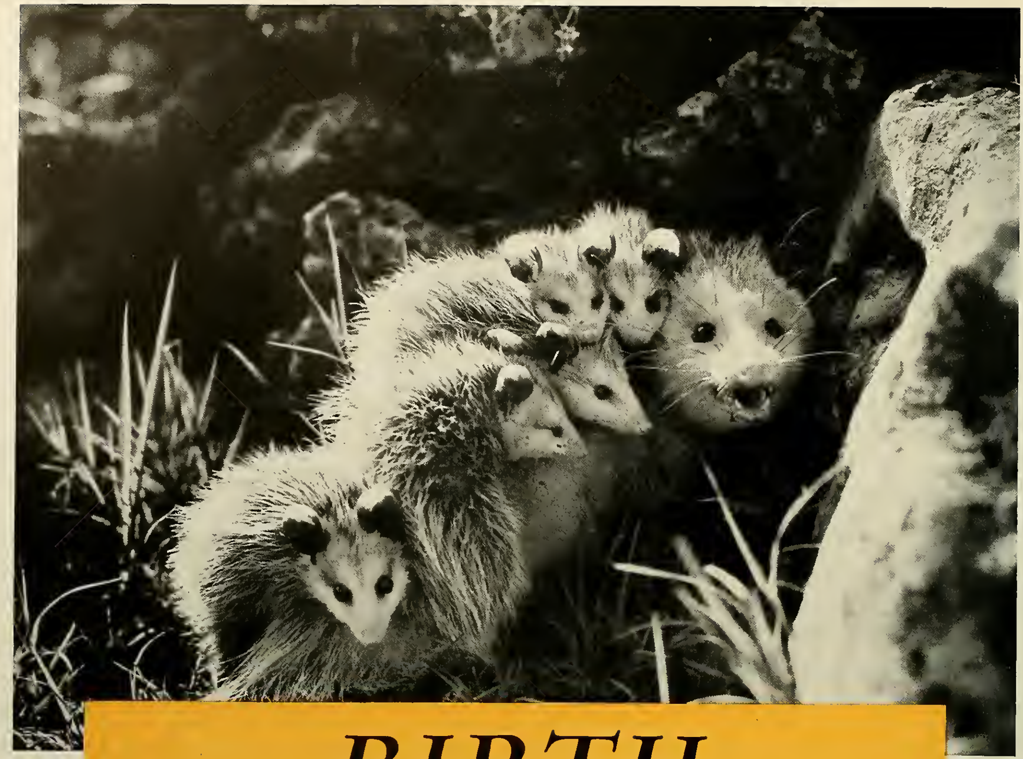


Photo by Hugh S. Davis

BIRTH
in the opossum family

By W. J. Hamilton, Jr.

The only animal in North America to raise its young in a pouch is spreading northward, to provide an interesting object of observation for the nature lover

Perhaps none of our native mammals has excited more curiosity than the opossum, *Didelphis virginiana.* Its appearance alone is sufficient to arouse interest, and when we inquire into its mode of life, we find these most distinctive.

The opossum may be recognized by its long gray hairs, mixed with white and black, its white face, black and white naked ears, and long prehensile tail, which is quite devoid of fur. It is about the size of a house cat, varying in weight from three to seven pounds, although individuals often attain a greater weight.

In one form or another it is found throughout most of the United States, and in spite of persistent persecution by man, manages to maintain its numbers from year to year. Indeed, its numbers are even increasing, and reports during the past half century indicate that it is spreading into the north. In central and western New York the opossum was a curiosity 20 years ago, so much so that trappers, who took an occasional one in their skunk traps, were at a loss to know what manner of beast they had caught. For years it has ranked as an important game and furbearer in all of our southern states; soon, it appears that the opossum will play a like role in the north.

The opossum is no epicure. It feeds upon what is available, eating fruits and berries, worms, insects, snakes, small mammals and birds, carrion, garbage, and almost anything edible which happens in its path. From the stomach of one trapped near Ashville, North Carolina, I took a tiny box turtle, almost entire. It delights in the persimmon, feeding recklessly

◄ **NATURE'S HITCHHIKERS.** The lover of wildlife has a rare treat in store if he lies in wait to see the mother opossum's young clamber to her back, grasp her loose fur with their strong fingers and toes, and ride with her on her noctural journeys

on the fallen fruit or climbing into the branches to gather the frost-tinted crop.

Through the long Indian Summer, the opossum has fed with abandon, increasing in weight and storing a substantial layer of fat for the inhospitable months ahead. With the advent of freezing weather, *Didelphis* becomes less active, sleeping through the day and part of the dark hours in a state bordering hibernation. But the opossum is not a true hibernator. Unlike the woodchuck, its temperature does not appreciably drop, nor is it loathe to venture forth when the pangs of hunger assert themselves. In the northeastern states, the tell-tale tracks of the opossum are often clearly marked on the new fallen snow.

My first glimpse of this peculiar beast was during the severe winter of 1919-20. The marshes and tidal flats near the site of the World's Fair at Flushing, New York, had frozen over during the cruel sub-zero weather, and the muskrats, which I had been trapping, moved into the higher ground. I had placed one of my traps in a burrow beneath a venerable willow tree in a cemetery, in the hope of catching one of these fur-bearers, for at that time their pelts were fetching fabulous prices. Imagine my surprise, on visiting my trap the following morning, to find an opossum in the trap. In spite of the arctic weather, it was very much alive, and showed no intention of playing "possum."

This matter of feigning death has made the opossum famous. Falling on its side, it lies quite motionless until shaken by the hunter or his mongrel cur. Then only will it utter a low hiss or grunt.

Countless myths have arisen in regard to the mode of reproduction, for the peculiar structure of the reproductive organs and the occurrence of the abortive young in the pouch have given rise to many superstitious notions. The breeding behavior and development of the young have been carefully studied by Professor Carl Hartman, and thanks to his long and minute observations, we now know the breeding habits of *Didelphis* as well as our other common mammals.

After mating, the embryonic young develop within the uterus for eleven to thirteen days. During this period they are not provided with the complete equipment for receiving nourishment from the mother that most other mammals have. But the membrane known as the chorion surrounding the embryo functions in this way instead of the more highly developed placenta.

This apparently is sufficient for the few days of life in the mother's body. At the end of this period, the young, appearing like living abortions, climb out and make their way "hand over hand" through a maze of hair to the opening of the pouch. Into this they crawl and grasp a nipple. So firmly do they become attached that it is well-nigh impossible to remove them. Some years ago, while collecting mammals in Costa Rica, I caught a large opossum whose pouch contained a squirming mass of young, perhaps an inch and a half long. Even by pulling forcefully I was unable to dislodge them from the teats and finally had to anesthetize the parent to remove one or two for specimens.

At birth the young are so small that it would take 23 to equal the weight of a penny. They remain in the haven of the pouch for two months, nourished only by their mother. They may number 16 to 20 at birth, though there are but thirteen teats in the pouch. Thus the last to arrive are doomed to starvation.

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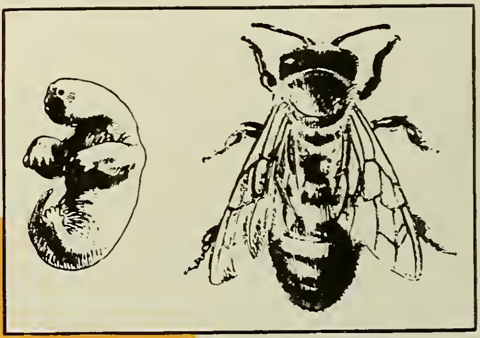
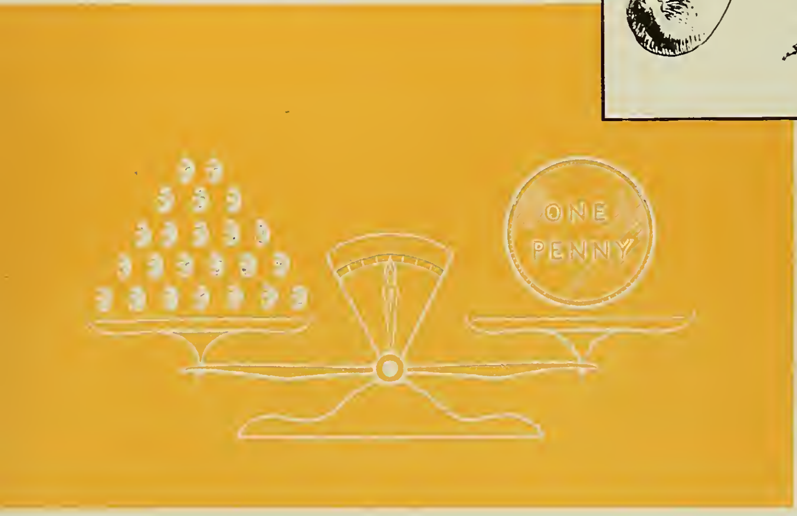


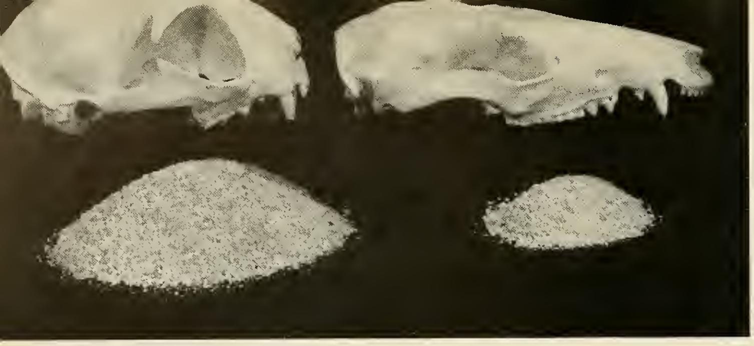
Drawing by Lloyd Sanford

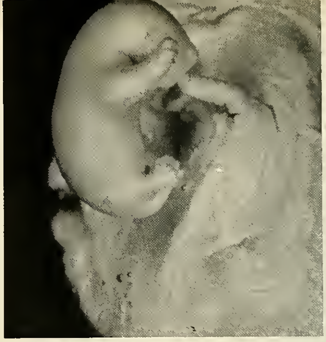
▲ **AN ADULT OPOSSUM** may weigh from three to seven pounds, but its offspring is smaller than a honey bee. The young are born in a most immature condition, but their fore limbs are relatively well formed. These enable the tiny creatures to climb hand over hand through a maze of hair to the pouch and firmly grasp a nipple



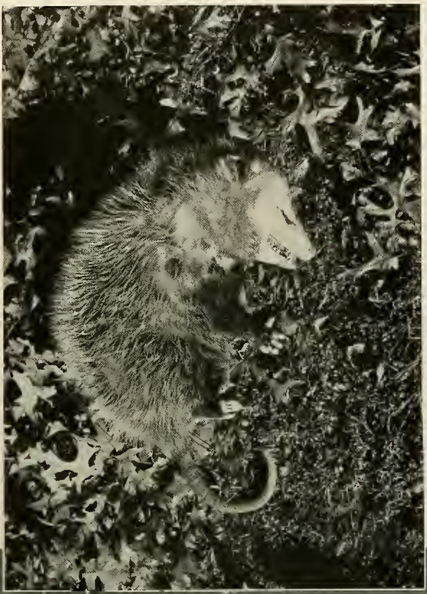
◄ **IT WOULD TAKE** 23 young opossums to equal the weight of a penny

Drawing by Helen Babbitt





(Above, right) In the pouch the two-day-old youngster shows little resemblance to the furry creature it will become



▲ The opossum is about the size of a house cat, but it has only a little over one-fifth as much brain capacity. In spite of this small amount of "gray matter," the opossum is not only holding its own in North America but is actually extending its range

Playing 'possum: an extraordinary photograph showing a live possum in the pose resembling death, for which it is famous. When confronted with danger, the opossum assumes this posture, exhibiting definite physiological changes which take place probably as a result of emotional shock. The habit may have saved the opossum from true death many times in the course of its long history. The Virginia opossum has changed little in size or structure during the past 70 million years

▼ A white opossum: a biological sport, or deviation from type

Photos by Hugh S. Davis

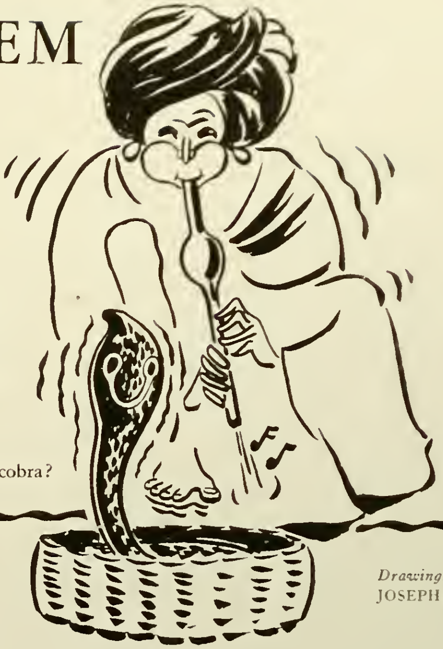
After this long "incubatory" period, the young, now well furred and the size of large mice, commence to explore the outside world. They first clamber to the back of the mother, grasping her loose fur with their strong fingers and toes, and ride with her on her nocturnal journeys. Not until they are nearly three months old are they weaned. When they are the size of small rats, they leave their carriage, but remain together in loose-knit family ties for another month. In our northern states, probably a single litter is the rule, although the female is quite capable of producing two litters in a season.

The opossum is an important animal to the fur trade. It ranks about eighth in value to the trapper, not because of the price that the pelt fetches, but rather because of its enormous numbers. The animal is used in a number of ways. Large quantities were formerly exported to Europe, where the pelt was dyed to simulate skunk. In this country, the better northern hides are made into jackets and coats, but the chief use is in trimmings for inexpensive garments. During times of affluence, the best pelts have brought as much as two dollars, but in recent years 30 to 50 cents has been the top. Indeed, some New Jersey trappers received more for the carcass during 1939 than they did for the pelt.

Its northern migration should bring delight to the hunters, trappers, and particularly nature lovers, for here we find a most adaptable creature, endowed both with economic importance and most unusual habits.

DO YOU BELIEVE THEM ?

Or do you think that some of the most startling and widely accepted beliefs about animals are pure fiction?



Does music charm the cobra?

By Clifford B. Moore
Director, Trailside Museum, Springfield, Massachusetts

Drawings by
JOSEPH M. GUERRY

Snake charming

The professional snake charmer with his stock of serpents (usually cobras), musical business, jugs, etc., is a familiar sight in many parts of the Orient, India, and even Egypt. Certainly the most mysterious element about the so-called snake charming is the apparent response of the snakes to music. This seems all the more mysterious since it has been conclusively proved that snakes are quite deaf and that the old adage, "deaf as an adder," holds true.

The reader has at some time seen pictures from India of cobras "dancing" to the music of snake charmers. On the other hand, those who have hunted snakes have observed that a basking serpent is not frightened away by talking, shouting, or other loud noises. In an effort to ascertain whether cobras actually can hear, Frank Wall covered the eyes of several individuals with adhesive tape and then proceeded to make various sounds near by. Both the blowing of a bugle and the beating of a large empty tin can close to their heads had no effect in arousing them. But on the other hand, if anyone walked along the floor near by or moved a chair, the snakes instantly reared up. This showed that the hearing was confined to and resulted from vibrations transmitted through solid objects in contact with the snakes. The reader can hear in the same manner the approach of a distant train by putting his ear to the steel rail.

The professional snake charmer is generally very careful to move his arms or legs incessantly or to sway his body back and forth while performing, and it is this rhythmic motion that "charms" the sensitive cobras and makes them appear to be dancing to the music.

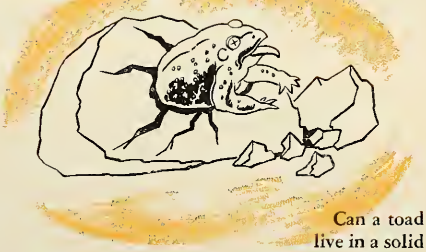
The charmer's flute or other wood-wind instrument is played mainly to impress the observer, and it naturally has no power of inducing the cobra to come out of its jug into public view. The coming out is often induced in an unobtrusive way and appears as if in accompaniment to the music. It is actually done by the charmer's heavily and persistent thumping on the ground or the side of the jug with a switch, chain, or drumstick.

Hopper woppers

There is certainly a very widespread feeling that toads can remain alive for many years sealed up in blocks of cement or in rocks. This problem apparently perplexed our forefathers as far back as 1777, for at that time a French scientist, M. Herissant, went to work and proved beyond a doubt that a toad will survive for many months without food, but that when sealed up in masonry and thus deprived of fresh air, it immediately perishes.

Ditmars suggested a reasonable explanation for conserved toads. "Toads," he said, "are known to burrow deeply into the earth during a drought in search of damp ground. They return to the surface when infiltration tells them of returning rains. At such times they exist for months in a state bordering on suspended animation." It might follow that on breaking up a large chunk of dried and parched earth, which, by its peculiar condition resembles brittle sandstone, one might therefore uncover a live toad in æstivation or in a state of "suspended animation."

We know of two cases of hermit spadefoot toads being encased in hard chunks of earth and being dug up alive and well. This species of toad has the habit of persistently digging into the earth. In desert and sandy regions of the Southwest it may remain in its burrow during the hottest part of the day to avoid being literally baked and evaporated by the scorching sun. In both of the cases referred to, the toads had retired into their burrows, pulling the earth or loose sand in around them. Apparently before the toads dug themselves out, infiltrating rain water and sunlight had virtually baked and made chunks out of the soil, fortunately leaving a few cracks, pores, or crevices through which fresh air reached the imprisoned toads. The people who first observed the two toads gave the opinion, in the presence of the author, that the creatures must have been sealed in for "many years."


Can a toad live in a solid piece of rock?

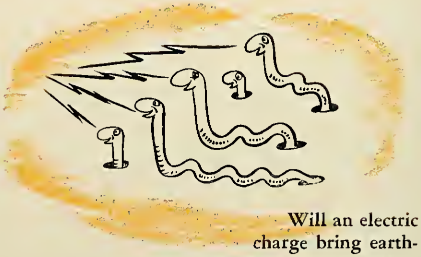
One spadefoot toad which received a good deal of publicity a few years ago and which was said to have been found "sealed in a concrete wall" was, on investigation by the author, revealed to have actually gotten into a crevice in a concrete cellar foundation —a cranny in the concrete which was formed by the falling out of a stone about the size of a baseball. Anyhow, it was a pretty snug fit, and when first disturbed, the toad puffed up its body, giving the impression that it was fairly well "sealed in."

Some such explanation can usually account for toads that appear to have been buried alive in concrete or rock. Actually we have no evidence indicating that it would be possible for a toad to survive for any considerable length of time in a block of stone or concrete.

Coaxing earthworms up out of the soil

Ever since man first went angling (and that was a long, long time ago), all manner of schemes and devices aiming to deceive and entice earthworms from their homes have been tried out and perfected. The fact that earthworms might come out of the ground of their own free will, regardless of all these strategies, was little considered by most of these over-enthusiastic and theoretical inventors. The result is that much time and money has been spent and a legion of gullible sportsmen have been "taken in," hook-line-and-sinker.

One of the methods in greatest vogue is the so-called vibrating of the ground. This is based on the assumption that when soil is agitated, the worms within it are disturbed and made to emerge from their burrows. An area of ground that bears evidence of the presence of earthworms (usually through their castings) is located, and the collector hammers or knocks against it to induce the worms to emerge. A variation is to drive a wooden stake into the ground to a depth of about one foot and to knock against the side of this until the worms appear.


Will an electric charge bring earthworms to the surface?

Another method, described as "fiddling," employs a stake like that previously described, but instead of knocking against it, the operator rubs the side of a thin board across the top of the stake. This sets up a shuddering or vibratory action which, in turn, is thought to be transmitted for some distance.

It is well known to all who have studied the earthworm that its nervous development is of a most elementary sort. Upon the slightest disturbance from without, the worm will instinctively recoil or retreat more deeply within its burrow to safety. The reader who has tried to dig up earthworms with spade or garden fork will find an excellent illustration of this principle. Unless the worm is immediately pulled out

Other conceptions and misconceptions in the realm of natural history on which the reader may test his knowledge, appear at right. The answers are given on page 220

1. Will a circle of rope on the ground around you while sleeping protect you from rattlesnakes?

2. Are elephants deathly afraid of mice?

of its burrow upon being exposed, it will completely disappear from sight down the same burrow.

Controlled tests were conducted by the author using the "knock wood" and "fiddling" methods in different soil areas inhabited by large numbers of earthworms. These tests consistently and conclusively showed that instead of earthworms coming to the surface as claimed, the creatures sought refuge deeper in the soil. In every respect, our conclusions confirm those of W. R. Walton of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture.

Earthworms are able to distinguish between light and darkness and will retreat into their burrows from a sudden bright light, particularly when flashed on them at night. This fact should be taken into account by prospective anglers who go hunting for worms after dark with bright lights. A dim or diffused light may, however, give some success to those who prefer the flashlight to the spade. "The best light for the purpose," maintains Walton, "is a flashlight fitted with red glass, as red light does not frighten the worms."

Will discharges of electricity into the soil bring earthworms up? Some years ago, Prof. Robert M. Yerkes of Yale, proved with his "**T**-maze" that worms will retreat from the source of an electrical charge. The maze was set like a letter **T** so that the worm, after reaching the end of the straight path and then turning to the left, crawled over sandpaper and received an electrical shock. With repeated practice, involving some 50 trials, the worm learned to turn to the right and so escape from the tube.

Devices are now on the market which work on the theory that by receiving a charge of electricity through the surrounding soil, earthworms will rise to the surface. In actual practice and with some variation on the Yerkes experiment, we found that these devices instead of bringing the worms up, made them go deeper. Earthworms within eighteen inches of the two metal conducting rods worked down to a depth of one and one-half to two feet beneath the surface within ten minutes. But farther than eighteen inches from the poles, even a fairly high voltage became so diffused as to be virtually ineffectual.

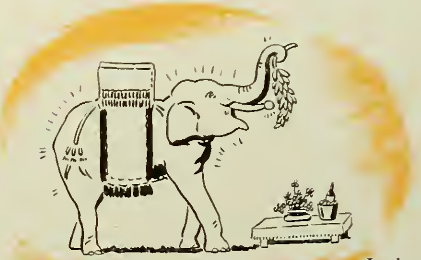
The correct inference to draw from all this is that there is nothing so effective in locating earthworms as some of that good old-fashioned foot power applied to the garden spade.

Is there such a thing as a white elephant?

Although elephants are never actually white, there are elephants whose skin is pale gray, with pinkish blotches. Far from being a burdensome possession as our phrase "white elephant" implies, however, these animals are greatly prized and even worshipped in Siam, and the captor of one is handsomely rewarded.

Years ago, a king of Siam had six white elephants at one time. Each resided in a palace of its own near the king's and had ten servants to tend its needs. The royal animals were fed on sugar cane, bananas wreathed with flowers, and fresh grass. Every afternoon dinner was served on spotless white tablecloths spread near a marble fountain in a shady court. The animals' tusks were ornamented with gold, and their heads covered with gold mesh. Small and exquisitely embroidered cushions were placed on their backs.

P. T. Barnum, who brought "Jumbo" to America, spent a fortune trying to obtain a white elephant for his circus. His representatives who journeyed to Siam were regarded with scorn after explaining their mission. However, one "white elephant" was bought from a lady of nobility whose dwindling fortunes made it no longer possible for her to keep her treasure in customary elegant white elephant style. The animal, sad to relate, died en route to America. Not to be discouraged Barnum later succeeded in bringing back to America a white elephant called "Toung Taloung." This animal received a star billing in the circus, but most people who beheld him were sadly disillusioned and disappointed to find he was not really white.



Is the white elephant an imaginary animal?

The expense involved in maintaining a white elephant which, save in a circus, has no value, was so heavy that the term "white elephant" became a common one to denote any impractical and costly possession or undertaking.

3. Do snakes commit suicide by biting themselves?

4. Do elephants with waning strength set out on a secret jungle trail for a graveyard marked out by elephant herds as their final resting place?

5. Does the horned toad found in our Southwest squirt blood from its eyes?

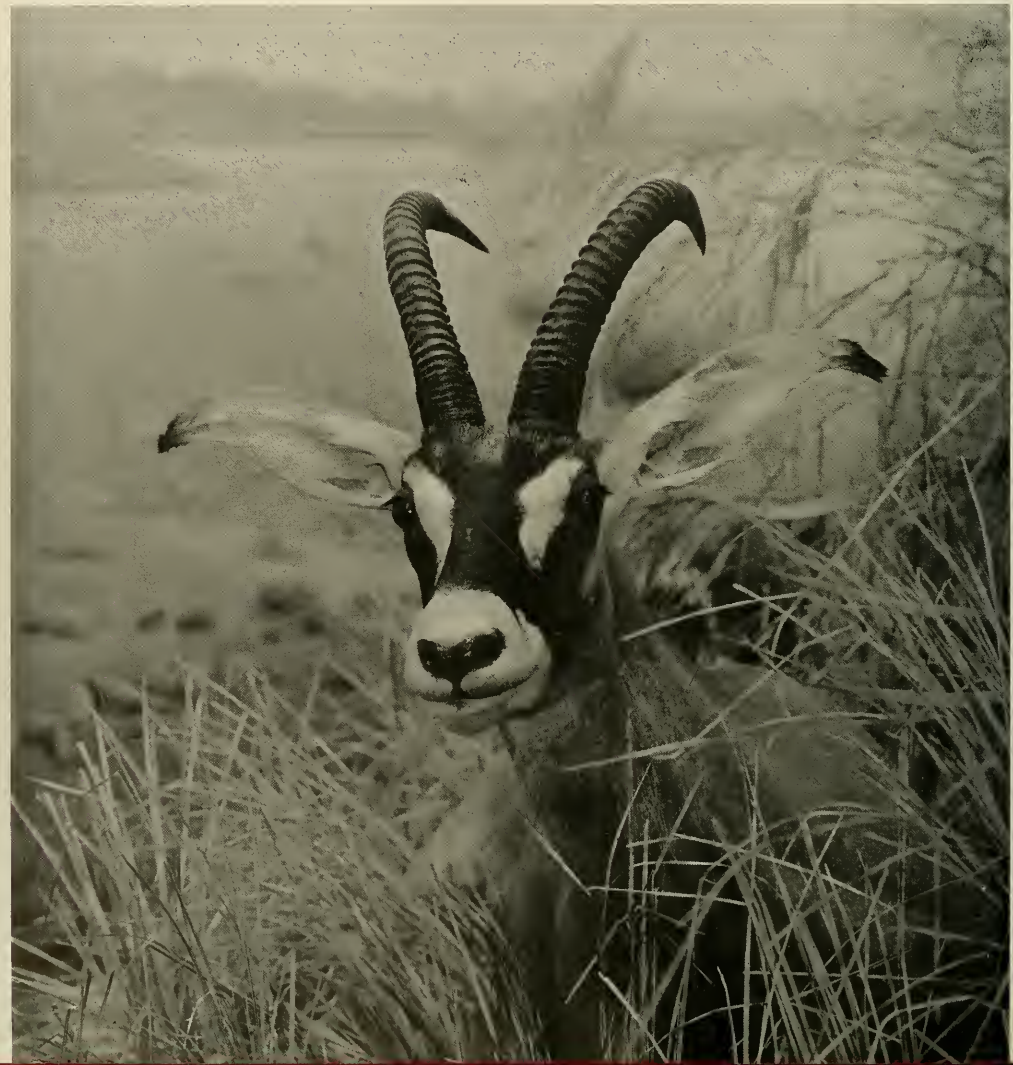
6. Do chameleons take the color of different objects upon which they are placed?

WILDLIFE
OF THE
UPPER NILE AND SUDAN

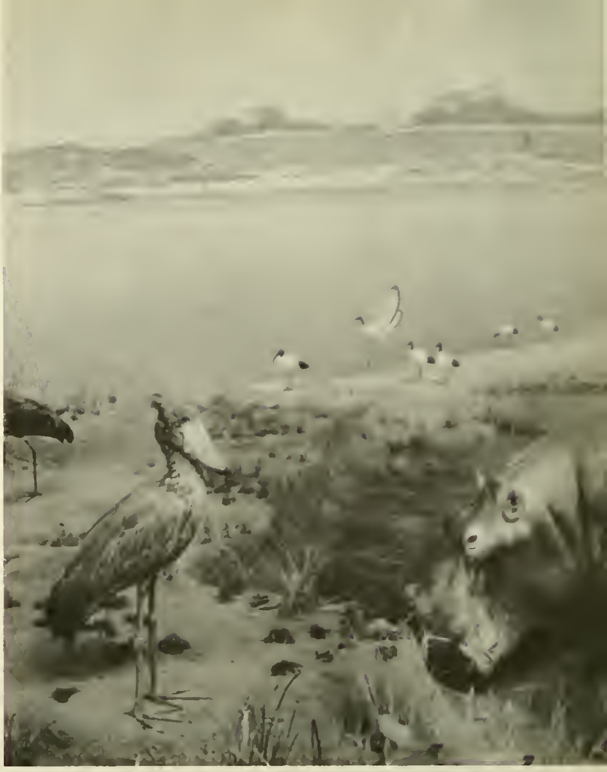
Animals far different from our own graze on the broad plains of Africa beneath the airplanes which crisscross daily in the conduct of the war.—Recent exhibits in Akeley African Hall at the American Museum

The roan antelope *(Hippotragus equinus bakeri)* is easily distinguished by the prominent markings on its face and by its stout and comparatively short horns, curved like a scimitar. It is a light grizzled brown in color. It stands about 4 feet 9 inches at the shoulders and is one of the most graceful of the antelopes. Roan antelopes are found over a large part of Africa from the Sudan south to Rhodesia, and they usually travel in small bands of about five to fifteen

Photos by C. H. Coles and T. L. Bierwert

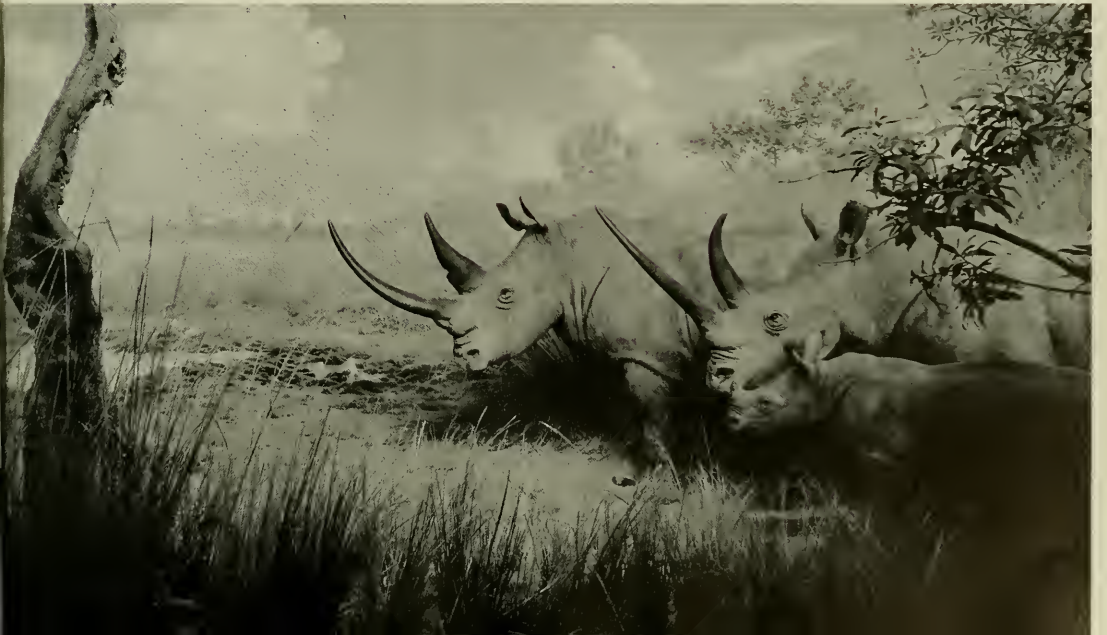


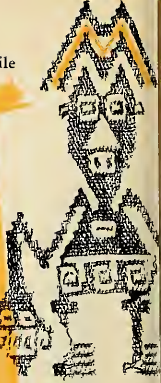
Also in the Upper Nile Group are displayed the fantastic shoebilled stork and the hippo, in a beautiful setting typical of their homeland. Despite the unwieldy and enormous bulk of the hippopotamus, often amounting to from two and a half to three tons, it is able to move with agility. Usually the disposition of the hippopotamus is mild, except when wounded or when its young are attacked, at which time it can ably defend itself. It is largely nocturnal, sleeping during the daytime in deep pools or basking in the sun, half-immersed in the water. So highly has the art of displaying animals been developed that the spectator standing in front of the exhibit can scarcely tell where the foreground merges into the painted background. He may have difficulty convincing himself that the birds at the water's edge are not mounted specimens



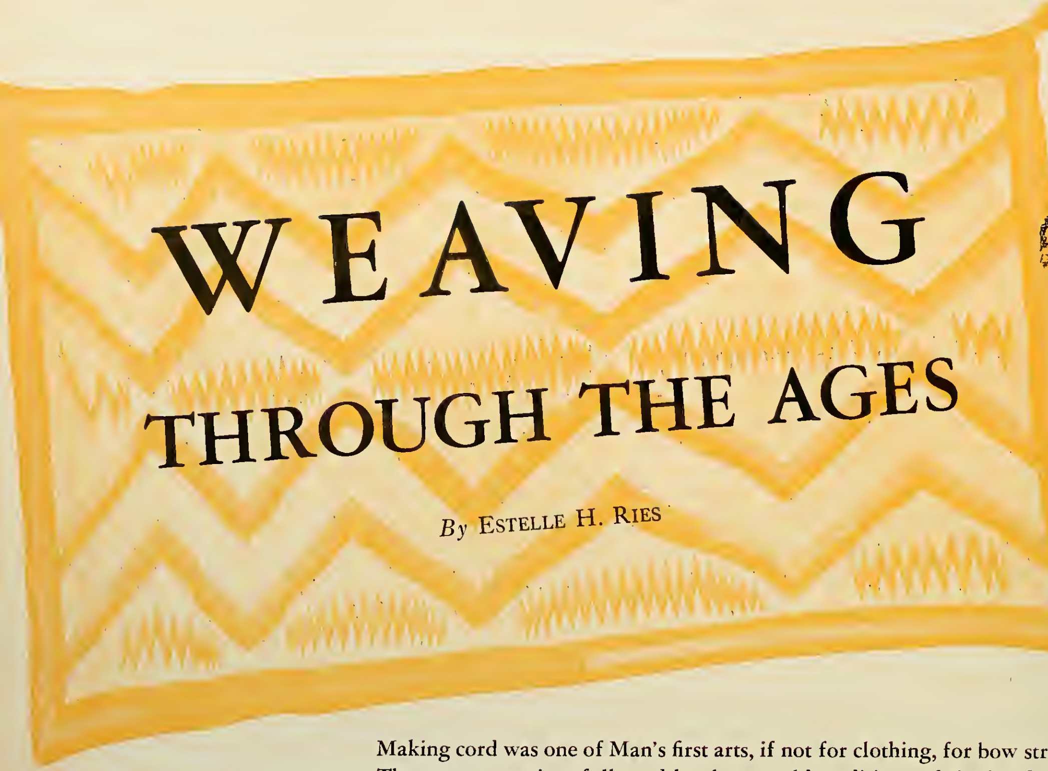
These groups were created under the direction of James L. Clark. The animals of the Upper Nile were mounted by G. Christensen and Louis Jonas, the foreground by Messrs. Petersen, Mason, and Freund, under the direction of Albert E. Butler. The background was painted by Messrs. Wilson and Kane, and the birds by Francis L. Jaques. The animals of the White Rhino Group were mounted by James L. Clark. The foreground of this group was done by Messrs. Petersen and Mason, under the direction of Albert E. Butler, and the background by J. Perry Wilson

The white rhinoceros, attaining a length of fifteen feet, is second in size only to the elephant among living land animals. Its formidable horns are neither tooth nor bone, but are compacted hair. Its eyesight is of limited service in detecting a possible enemy, but the nose and ears are acute. The white rhinoceros is much less prone to charge than is the black, which can at times become dangerously aggressive. Not actually white as the name might imply, this inhabitant of the Sudan is only slightly different in color from the darker gray of the so-called black rhino. The main difference is in the head and particularly in the muzzle, which is square rather than pointed





(Right) A DESIGN from an old Peruvian cotton textile



WEAVING THROUGH THE AGES

By ESTELLE H. RIES

Making cord was one of Man's first arts, if not for clothing, for bow strings. Then came weaving, followed by the age-old traditions of the handicrafts and finally by industrialism with its complex tangle of synthetic fibers

WITH the wool shortage and the consequent ban on waistcoats, pleats, patch pockets, and trouser cuffs, scarcely any civilian industry is more in the news today than textiles. However, the term is not restricted to clothing. Textiles confront us in every phase of home furnishing. We walk on them in the shape of rugs; our chairs and couches are upholstered with them; as draperies they ornament our windows, and in every room they are conspicuous in minor ways as well. Until recent years silk, wool, linen, and cotton were the sole materials for most decorative textiles. Now war and the claims of government priorities have accelerated the already rapid development of synthetic substitutes.

Indeed, the manufacture of textiles is a hallmark of civilization. Yet one of the earliest needs of primitive man was not for dress, but for cord. Whether he dressed or not, he needed fiber for a bow-cord, a sling, a net, or a snare, and other necessities so that he might overcome his dread of preying animals and obtain meat, fish, and other products. Making cord was one of his first arts (or hers, for it was usually woman's work), and cord was used for these other purposes long before man thought of weaving a fabric from the strand.

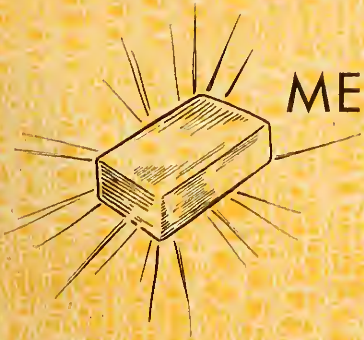
The spider weaving its silken threads, the birds interlacing grass and twigs into nests, gave early man a model and an inspiration. One historian suggests that a shepherd boy tending his flocks noticed a lock of wool which caught in a bramble, and upon twisting it found that the fibers would hold together. From such a beginning we may have evolved yarn.

Examples of weaving dating from the New Stone Age were revealed in 1853, about 4000 years after they were made, when a hot season lowered the level of Lake Zurich in Switzerland. In the mud were found relics of daily life in that prehistoric time. The fragments were of linen, black or brown, and showed a variety of designs and technique.

The best linen of ancient times came from Egypt and was in great demand over much of Asia. One of the most important officials in the Pharaoh's administration was the Director of the King's Flax. With only primitive looms at their disposal weavers achieved a remarkably fine fabric.

This was accomplished through skillful application of the laws of physics and chemistry, even if they were not identified as such. While chemistry is a young science, it is an ancient art. Ages before man

N HAS WOVEN



METALS
FROM THE
EARTH

BARK FROM
TREES

BASSWOOD

MILKWEED

FIBERS FROM
PLANTS

FEATHERS FROM BIRDS

SILK FROM
INSECTS

WOOL AND HAIR FROM
ANIMALS

Drawings by HELEN BABBITT

had any knowledge of chemical formulas, he stumbled upon countless ways of putting chemistry to work. He found methods of saving time and hard labor by improving his materials and even creating new ones. Only within the last century and a half have we acquired a systematic scientific knowledge. But without any exact knowledge, our ancient forebears discovered how leather could be tanned, why linen could be bleached, or what happens when sand is fused into glass. Such old chemical secrets were discovered through a long series of accidents.

The linen bleachers of Thebes for ten centuries profited by a trade in linens that extended the whole length of the Mediterranean. What was their secret, handed down from father to son and practiced with such skill and patience? Before spreading the linen out in the sun, they treated it with a potent, magic powder prepared by the priests in the Temple of Ammon-Ra, and no doubt they attributed a large share of its success to the powerful god with the ram's head. A few of the shrewder of them may have suspected that their mysterious salts of Ammon were dried and powdered camel dung, but not one of them ever had an inkling that the efficacy of this remarkable preparation depended solely upon the ammonia in the manure—the ammonia that in a later millennium some chemist named for the old temple of Ammon-Ra.

Obviously the bleaching process had to be speeded up in modern times. Someone has calculated that there are not enough open green fields in the whole of the British Isles to provide "bleaching walks" ample enough to whiten the cloths of a single mill town. For all that, there are occasionally found little villages in Ireland, today's land of linen, where the natural outdoor bleaching methods are adhered to with special pride and where the harsher industrial methods are in disrepute.

Early spinning was done by holding a bunch of fibers under the left arm. Later this bunch was wound on a stick called a distaff, and since the performance of spinning was woman's work, the very word, distaff, has become a synonym for woman's authority or domain, or for women collectively. The woman who spins was called a spinster, and it is interesting to notice that she worked upon a single thread. The word wife, however, is related to weave, and she interlaced and unified the separate threads of a fabric even as she did the separate members of her family into a harmonious household.

In our everyday speech we show the high value put upon the arts of the loom, for do we not call a valuable thing which has come to us from the past an heirloom? Perhaps the most famous loom story is that of Penelope, the grass-widow of the long absent Ulysses. Several suitors paid her attentions, but she told them to wait until she might finish the work on her loom. Every night she unraveled what she had done during the day, showing that even in Homeric days, women could tell a good yarn as well as work with one.

However, the finest examples of ancient textiles come, not from the great centers of the Old World, but from Peru where the art had reached a very high stage of development before the coming of Pizzaro, the conqueror. Without any of our modern appliances they produced virtually every kind of weave and textile decoration our factories put forth today. They made thread from cotton and from the wool of the llama and alpaca. Experts have stated that Peruvian spinning not only surpassed the best machine spinning but contained the application of certain principles unknown today. In evenness of size, in strength and fitness of purpose, the ancient Peruvian yarns are considered perfect.

The moth and the mulberry leaf

The silkworm, only three and one-half inches long, spins the strongest, most elastic natural fiber known to man. Used in a primitive sling it enabled the savage hunter to perform previously unknown feats of marksmanship—propelling his missile straighter, farther, faster. Industrially or in the home it is the best of sewing threads. The gluttonous little producers of this miraculous fiber must be fed their mulberry leaves every two hours—one ratio given is 1700 pounds of leaves for twelve pounds of silk. Leaves are digested into a gum. The latter is spun into threads, which in turn are woven into a cocoon. From the cocoon, man extracts and prepares the silk used for weaving our loveliest textile creations.

Probably no other fabric gives such depth, fire, and brilliancy to color, or under other treatment, such dreamy opalescence. Had the Chinese had their way, perhaps none of us would know how silk is obtained. They kept the secret of its origin concealed from other countries for 2000 years by threatening to behead anyone disclosing it. They sold the beautiful completed product to the Persians, who in turn sold it to other nations of the civilized world without having the slightest idea as to how it was made or what it came from. But finally, legend has it, a Chinese princess, engaged to an Indian prince, could not bear the idea of replenishing her beautiful silken trousseau with cotton, which was the only fabric to be had in India. She hid some cocoons in her headdress when leaving her country, and thus silk was carried to the land of her spouse, whence it became known more widely throughout the Far and Near East. So great was its reputation for sheer delicacy that it was called "woven wind."

Another story has it that the silkworm was introduced from China to Europe by missionaries who carried the eggs in a hollow of their staff.

In the twelfth century, Roger the Norman, King of Sicily, made some conquests in the Eastern Empire, taking Corinth, Thebes, and Athens, and carrying off the silk-weavers to Palermo. He established them in a royal factory connected with his palace and compelled them to teach their art to his own craftsmen. Thus Sicily became the great center of silk making, which later spread to Italy, making this the chief European source of the fabric down to the present time. King Henry IV of Navarre spent great sums developing silkworm-growing in France, and Queen Elizabeth was the first in England to entrust her legs to silken hose. James I imported 10,000 mulberry trees to be sold at three farthings each in an effort to encourage silk cultivation in Great Britain. One of these trees enjoyed the distinction of being planted by William Shakespeare in Stratford and was later made into a chair for the great actor, Garrick. However, both climate and labor conditions doomed the experiment of silk cultivation to failure.

Textiles of silk, damask, and velvet reached their high point in the fifteenth century in Genoa, Florence, and Venice as well as in cities in Spain, and the greatest artists were willing to create designs for fabrics. Velvet, often called by its French name, velours, is a woven silk fabric having a short nap of erect loops, these loops being either cut or uncut. In the antique stuffs, areas were left uncut, forming a design against the cut pile. Brocade is woven silk stuff whose design may be only a difference of weave or may be of different color, further enriched by the use of superimposed gold and silver thread. Brocatelle is a heavy woven fabric of coarse texture, figured like brocade but usually made of wool and silk. The characteristics of silk in all its forms are softness, luster, luxuriousness, formality, courtliness, and conventionality, all of which were wonderfully adapted to the showy pageantry of the Renaissance.

"Vegetable lamb"

In earliest ages while our ancestors were still dressed in skins or wool, European travelers spoke of Asia as a wonderful land where wool grew upon trees in fleeces more beautiful than those of sheep. Vegetable lamb, the cotton plant was called.

Today the effect of cotton and its countless valuable by-products upon industry, commerce, finance, and politics is enormous. The need for manual workers adapted to work in the cotton fields was one of the principal reasons for the expansion of slavery, which led to the Civil War. Cotton has been a spur to England's colonial policy in Egypt, Australia, India, and elsewhere. The home spinning and weaving of cotton has been urged by Gandhi as a weapon in obtaining India's independence. Cotton is so important in our southern states that national politics must always reckon with it and often swing around it. During centuries of time, the infant's layette and the old man's shroud, and most of the textile needs between, have been provided by the cotton plant.

The use of cotton today far exceeds all other textiles combined.

The scene in the eighteenth century, however, differs strikingly from that of today. In England, textile industries employed not millions, but a few hundred thousand workers. They were often banded under a master for convenience and expediency, but spinning was really a home craft and could be done by the women at their own wheels. It was a long, slow process, and weavers were often idle because yarn-making could not keep up with them. The difficulty was aggravated in 1733 by John Kay's invention of the fly shuttle. This allowed one to throw the shuttle across mechanically instead of by hand, so that the speed of weaving was greatly increased, though the speed of spinning remained the same.

An invention named after a wife

In 1764, James Hargreaves, a poor, illiterate weaver, greatly relieved this situation by making a machine which spun eight yarns at a time as easily as one. His discovery was the result of an accident. His wife, Jenny, was spinning when the wheel happened to overturn. Hargreaves noticed that it kept on spinning just the same. This suggested to him that a number of spindles might stand upright and be spun all at once. He made a successful machine and named it a spinning jenny in honor of his wife.

Although Hargreaves was a plain workman, he was shrewd enough to keep his secret for his family's use. But the other spinners became suspicious of the great amount of yarn that came from the Hargreaves dwelling, and one day they mobbed his house and destroyed his machine. He had to flee to Nottingham where the jenny was ultimately appreciated.

However, it would not do everything, and another invention greatly advanced the industry. This was in 1769 when Richard Arkwright perfected a spinning frame in which the yarn was drawn out by a series of rollers, each pair revolving more rapidly than the one before.

These inventions were the forerunners of the Industrial Revolution in the Textile field. The laborer no longer owned the tools or machines with which he worked, nor had he anything to say about the product. Instead of managing his own time and life and doing a complete job from the getting of raw material to the finished product, he was placed in a factory that could hold the complex new machines and hired at a weekly wage. Sometimes he had but a single movement of the hand to repeat thousands of times a day. Huge sums of capital were brought together for running modern factories, and the corporation was developed as a suitable form of organization for this capital. Thousands of men were displaced by machines that could be run by a single boy or girl. At the same time, despite the confusion and suffering these changes entailed, the machines were a blessing to mankind as a whole, for they reduced the cost of necessities and made it possible for poor as well as rich to share in the good things of life. However, this possibility is but feebly realized. The problems brought about by the Industrial Revolution are still far from solved, and probably many changes of a fundamental character will be needed before our potential abundance can be enjoyed by all.

Cotton has always been more sought after for the brilliant dyes it held rather than for the beauty of the fabric itself, for compared to the fleecy softness of wool or the lustrous brilliance of silk, it is simple and unassuming. India was most successful in dyeing cotton. From its language we obtain the word chintz, which is derived from a Sanskrit word meaning spotted or bright. Cotton cloth was dyed many brilliant hues in Europe also. There it was called cretonne after the Normandy village of Creton, world famous for its weaving.

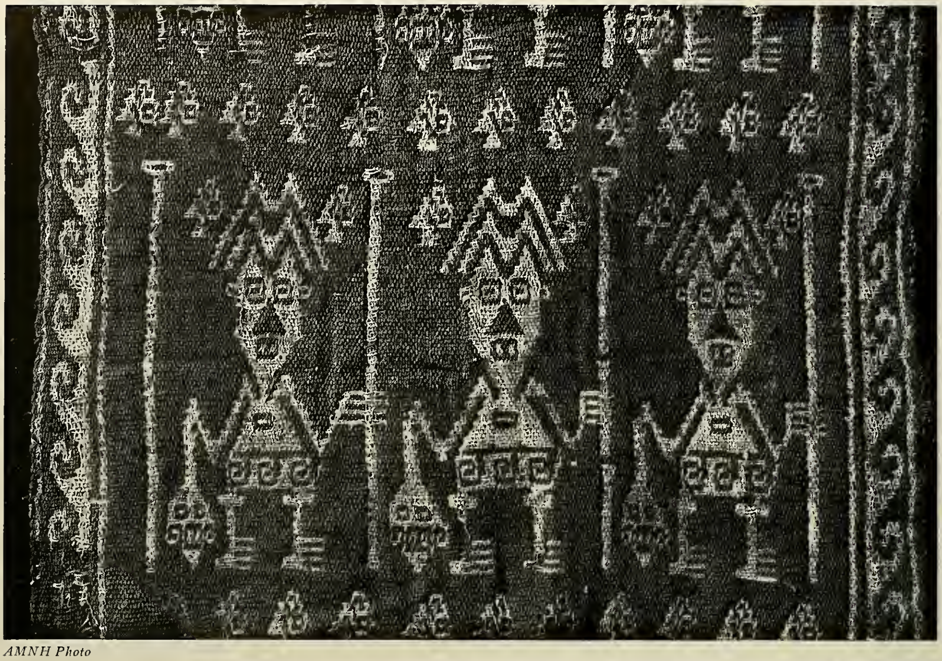
Colors in cloth

The chief beauty of textiles depends upon the color, and that in turn requires an art of dyeing. The art of coloring fabrics has been practiced from the most ancient days, almost since fabrics themselves were devised.

There are two types of dyestuffs: natural dyes, as old as the hills, and artificial or synthetic dyes, known for less than a century. The Egyptians, Indians, and Chinese early used rich colors obtained from plant and mineral sources, dyeing being a well developed art even then with limited facilities at hand. The ancient dyer was largely dependent on substances furnished by nature in a form ready for use. Natural vegetable dyes were obtained from leaves, stems, barks, roots, and fruits of plants and trees. Cochineal was derived from the dried bodies of red female insects. Indigo came from the fermentation of leaves and stems of the indigo herb.

Many of these dyes were rare, costly, and hard to work with. One had to be literally born to the purple, for only princes could pay $600 a pound for linen treated with a wonderful substance which was coaxed drop by drop from two tiny sacs possessed by a sea snail off the coast of Tyre. The dye was a thick, white liquid that smelled like garlic. Spread upon a cloth in the sun and air, it turned green, then blue, then purple. Wash the cloth with soap—that is, set it with alkali—and it became a fast cardinal red, still identified with the princes of the Church of

Woven from PLANTS



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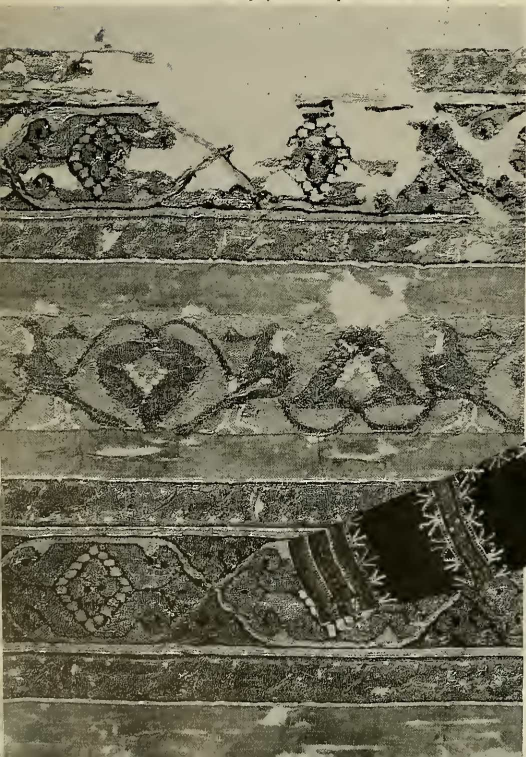
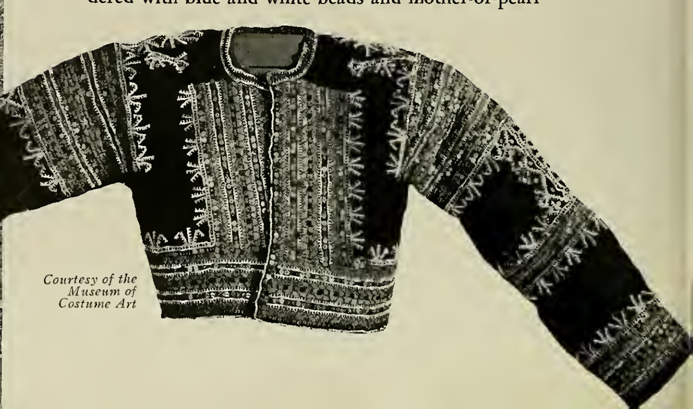


Courtesy of the Metropolitan Museum of Art

▲ COTTON. Some of the finest ancient textiles come from Peru, which produced the piece shown above, exhibited in the American Museum. This was woven from both sides of the loom, using two sets of warps and two of wefts. It has the same design or both faces but with solid masses reversed. The Peruvian Indians cultivated two shades of cotton: white and brown. Experts have stated that Peruvian spinning surpassed the best machine spinning and even employed certain principles unknown today

◄ FLAX. Time has weakened the Egypto-Arabic fabric at left but cannot obliterate the beauty of its design or the high art it represents. This cloth of flax from the early eleventh century bears tapestry-woven designs in colored silks and golden threads

▼ HEMP. The exotic textile below comes from the Philippine Islands. The dull red background of woven hemp is embroidered with blue and white beads and mother-of-pearl



Courtesy of the Museum of Costume Art

Woven from METALS

GOLD, copper, brass, iron, glass, and asbestos are among the mineral products which man has used for the weaving of textiles. Gold, long a symbol of wealth, was effectively woven in the damasks and brocades of the early Persians

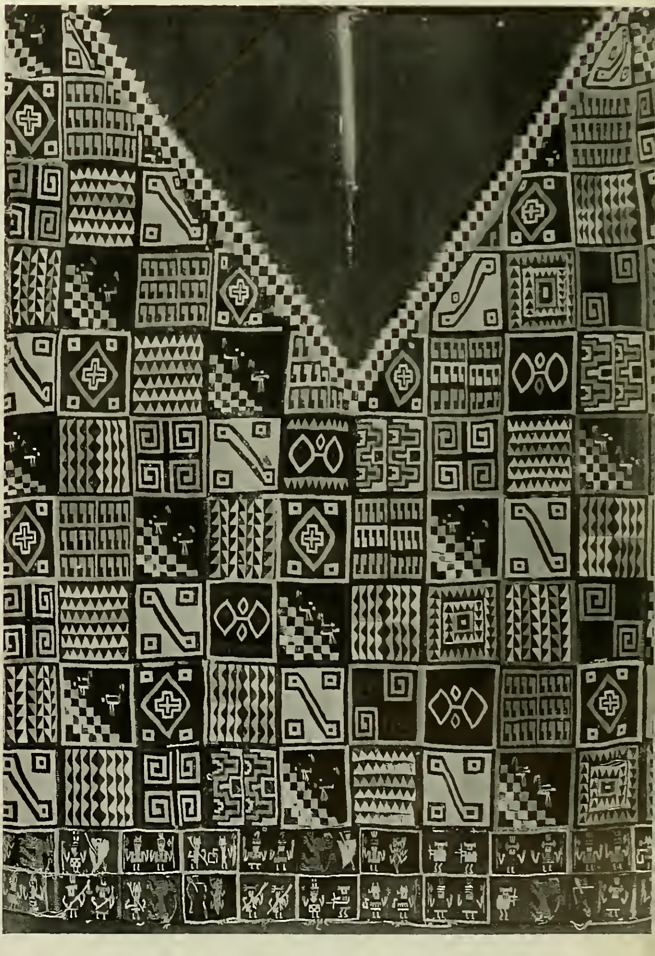
SILVER tinsel yarn in considerable quantity is woven into the Bolivian poncho below. The yarn was spun in Peru by twisting a thin band or ribbon of silver about a finished yarn of cotton. Human figures embellish the two lowest rows of squares. The upper squares show geometrical designs, with occasional flying birds

Courtesy of the Newark Museum and the Museum of Costume Art

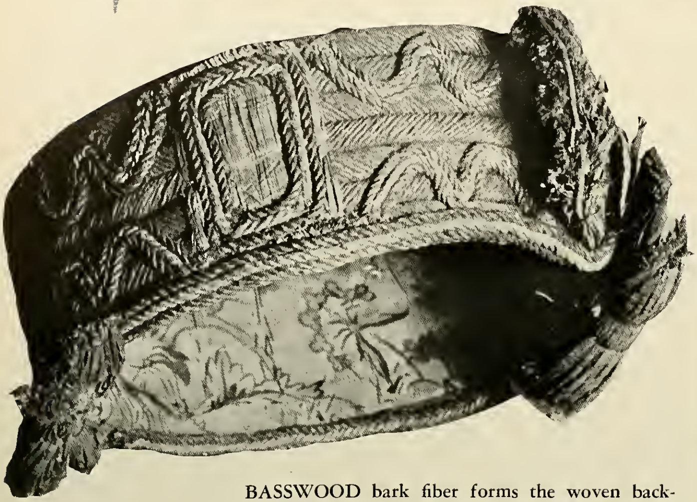
▲ GRASS. A rain coat from Korea, made of brown, closely-woven grass: an ingenious way in which man has used a common product of nature to meet the ever-recurrent problem of keeping dry in the rain

From Dykes' Genus Iris; *Courtesy of the New York Botanical Garden*

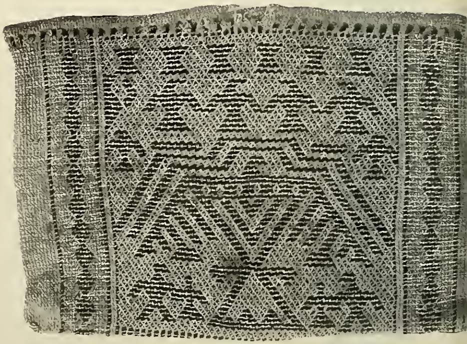
▲ IRIS. The Hupa and Yurok Indians of California made twine of fibers from the leaves of this flower ***(Iris macrosiphon).*** The fibers were separated from the leaf by means of a clam shell



TREES



CEDAR bark is the material from which the Indians of the North Pacific coast made the headdress at left, and also capes. Even today some of our wool clothing contains a large amount of fiber from the bark of the redwood. Hill people of Madagascar made garments by weaving thread made from the inner bark of three different trees, then beating the fabric to soften it



BASSWOOD bark fiber forms the woven background of the old Menomini bag at right, from the region between Lake Superior and Lake Michigan. The design, showing the Thunderers, is worked in buffalo wool yarn

ANIMALS

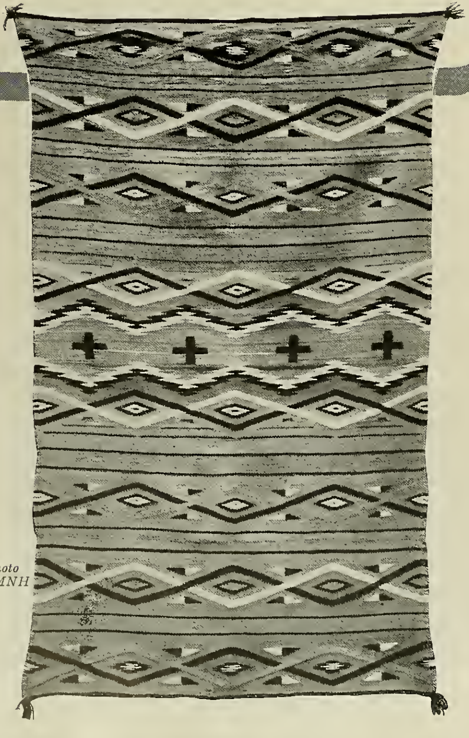
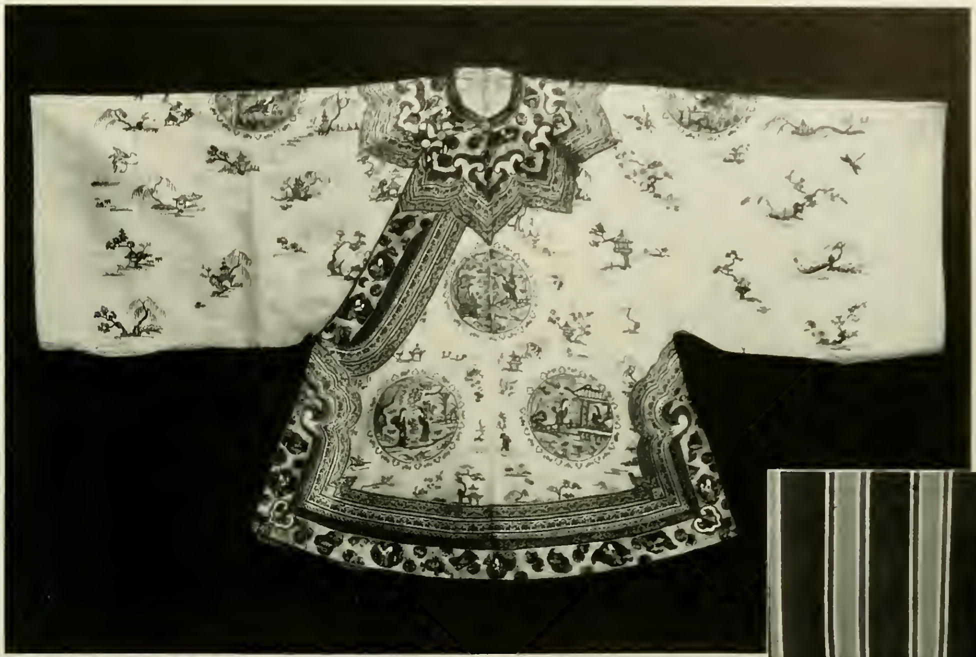


Photo AMNH

WOOL from domestic sheep provides the material from which the Navajos weave their famous blankets, a fine example of which is shown at left. Though neighboring Indians raised cotton and wove blankets before sheep were introduced from Europe, the Navajos do not seem to have done so. The ancient Peruvians wove with wool from the camel-like alpaca, llama, guanaco, and vicuña. Wild goat wool was used by the Thompson Indians of the West Coast, also by the Chilcat Indians of Southeastern Alaska in weaving the characteristic Chilcat blanket

HAIR from the buffalo was used in weaving war bags and other things by the Osage Indians between the Missouri and Arkansas rivers. Belts and other small articles were woven from buffalo, bear, and moose hair by Indians in the eastern portions of the United States. An animal product used in weaving with which fewer persons are familiar is babiche—thread or thong made of sinew, gut, or rawhide. The Dené Indians of northwestern Canada wove light bags of babiche for carrying game

INSECTS AND BIRDS



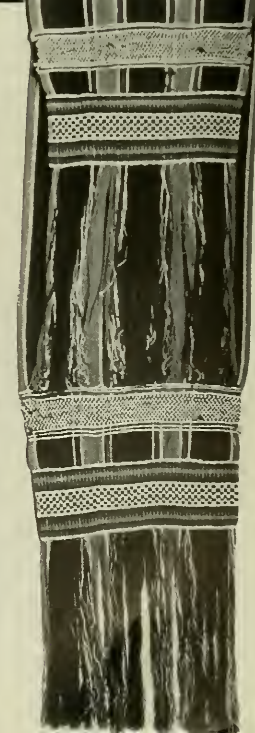
AMNH Photo

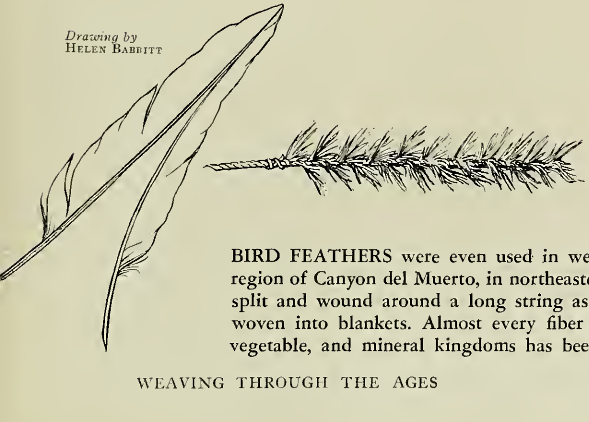
SILK perhaps excels every other fabric in depth, fire, and brilliance of color—qualities well exemplified by the gorgeous woman's jacket from Shanghai illustrated above, embellished with symbolic designs in gold and other colored thread. The history of silk has, over long periods of time, been well-nigh equivalent to the history of civilization in many parts of the world.

Today, silk is a strategic material owing to its use in parachutes and in the manufacture of bags containing explosives which will not leave an incandescent ash after detonation in large guns. A recent newspaper article claims the development of new types of silkworms in Venezuela that will spin in 8 fast colors and 18 shades

WILD SILK was used by the Betsileo tribe of Madagascar in weaving the loin cloth, or *salaka,* at right. The natives gather the cocoons of the wild silkworms, of which there are about 20 species, in making this type of fabric

Courtesy of Ralph Linton and the Museum of Costume Art





Drawing by
HELEN BABBITT

BIRD FEATHERS were even used in weaving by early Indians in the region of Canyon del Muerto, in northeastern Arizona. The feathers were split and wound around a long string as shown at left and were then woven into blankets. Almost every fiber or filament from the animal, vegetable, and mineral kingdoms has been used in the art of weaving

Rome. Such processes were typical until the middle of the last century.

Aniline dyes

In 1856, a seventeen-year-old English boy, William Henry Perkin, was experimenting in a laboratory trying to find quinine. Instead of getting nice clean crystals from the aniline oil that he was oxidizing, he got what the chemists detest—a black, tarry mass. When he went to wash this out with alcohol, he was surprised to see that it gave a beautiful purple solution. It was "mauve," the first of the aniline dyes. This started an industry which expanded the possibilities of beauty in the lesser arts beyond calculation. The British Government gave Perkin a title, but though England led the world in textiles and needed more dyes than any other country, she gave him no support in his efforts to develop the possibilities to which he held the magic key. Perkin's instructor, Hofman, a German, finally returned to Germany and practically took the infant industry there with him. Within a generation, Germany had the coal tar products business of the world in her hand. When war broke out in 1914, Britain with her billion-dollar textile industry, was crippled for the want of dyes, and in fact every country had to make new adjustments in the coal tar industry.

America now makes over 775 distinct coal tar dyes, from which it is possible to match any tint appropriate for coloring any material. Synthetic coloring materials are highly specialized. A dye suitable for wool cannot be used on cotton. One that is sunfast may not be waterproof. To match the exact shade in a straw hat, a rayon blouse, a homespun skirt, and a leather handbag may require 25 or 30 distinct dyes—a task that calls for the greatest skill of the dye manufacturer and the highest art of the color expert. While the manufacture of dyes is not a big business as we measure it in this country, American industries dependent upon dyes employ over two million men and women and produce over three billion dollars worth of products a year. Textiles use more than half the dyes.

Cotton, linen, silk, and wool are all dyed in different stages of their manufacture into cloth. They are dyed in the yarn, in the warp, and in the piece, or in the raw state before they are even spun. Some dyes are capable of coloring a material without the aid of any other substance, while others require an intermediate substance to fix or develop the color.

Now that color of any kind is so readily within call, we are devoting more attention to the quality of texture in fabrics, for texture harmony exists quite as surely as does harmony in color. Silk mellows light. Velvet adds warmth and richness. Where soft, rich color is desired, it is well to select velvet, whose silky luster makes deep shadows and high lights play in its folds. Numerous velvets are available, plain, striped, and of historic designs. Reproductions and inexpensive varieties may be had as well as those that more seriously tax the budget. When rich textures are employed, it is interesting to note that the color treatment may be much simpler than for coarser materials. Velvets, silks, and their derivatives are attractive even in one color, and a strong design detracts from the beauty of the surface finish. Plainer materials, such as cretonne, require bold color and considerable pattern, and these give to chintz the gay cheerfulness that makes it so charming.

Synthetic fibers

We are fascinated today by the dazzling variety of new synthetic materials, for example, fiber-glass—as beautiful as silk, yet rustproof, damp-proof, fireproof like glass itself. And there are shining cellophane, dull acetates, lacquered plastics, and non-tarnishing metals as well. Never before has the weaver possessed such rich and varied resources. Synthetic silks are now the word, and the worm that turned the world is threatened with being turned out. For more than 40 centuries, women have been thrilled as they dressed in the delicate, flimsy garments of this texture. Now it is being poured out by the millions of yards, not from the mouths of worms but the mouths of machines. For these 40 centuries, the worms have toiled for the few; now scientists of industry are working everywhere for the many—rich and poor alike. Here is the democratizing influence of a new industrial era. Such creatures of tradition are we, that for a long time we actually believed that the silk excreted by a worm was a more aristocratic substance than a similar fiber made in a clean test-tube out of pure elements. But that is perhaps a detail. Most important is the question, what of Japan? Before Pearl Harbor she annually sent us some 75 million pounds of silk, worth over $400,000,000 in good years. This used to be a restraining consideration of the first importance in her relations with the United States. In the years immediately preceding the war, we found a substitute for silk, but Japan has no substitute for those millions of dollars. With her income from silk, Japan paid for her imports of cotton, steel, and machinery. Having lost her American market she presses her treacherous attack ever more strenuously toward economic and political control of China and the Indies and possibly of Siberia as well.

But all is not gloom. For if militarism can be crushed and an equitable world economy established based on the Four Freedoms, Japan may well be able to resume her place in the family of nations on the strength of her silk production. Rayon, nylon, and other synthetic textile materials have outgrown their early connotation of artificial silk and no longer need to abolish the silk industry to assure their own success. On the contrary, synthetic textiles tend in some ways to strengthen rather than crowd out their companion fibers—silk, wool, and cotton. They have widened the use of each of these by the creation of new combinations of fabrics. Man-made fiber has a stabilizing effect on the entire textile industry. It is not subject to the whims of nature. Produced under human control there are no sudden fluctuations in supply or in price. Textiles are ready to rise harmoniously to the opportunities offered by an enlightened world policy. They wait only upon the world itself.

THE DEVIL'S TOWER

By H. E. VOKES

*Associate Curator of Fossil Invertebrates,
American Museum of Natural History*

A strange history lies back of this "impossible" shaft of rock, which a local rancher resolved to climb at a Fourth of July picnic. Rising more than 1000 feet above the plains of northeastern Wyoming, its forbidding profile can be seen for approximately 100 miles

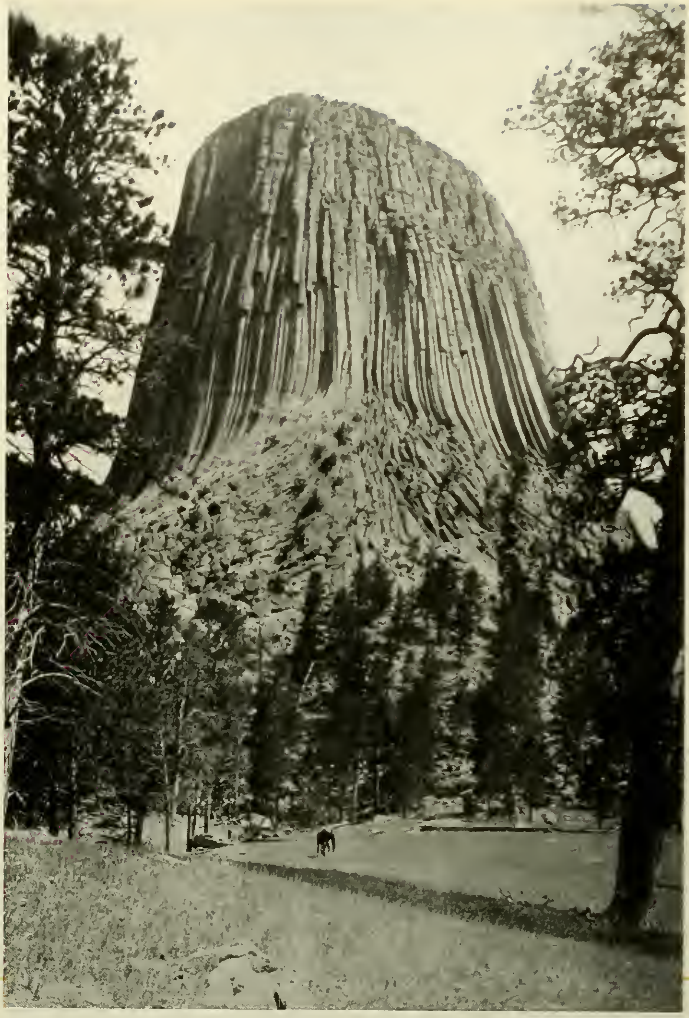


Photo by Albert Thomson

One of our most impressive landmarks: its origin and its lore

AMERICA'S humorist, the late Will Rogers, would have had many chuckles over the predicament in which a namesake of his found himself on the Fourth of July, 1893. It all started when a big holiday celebration and picnic was planned in northeastern Wyoming, and the committee in charge of arrangements could not think of a headline event that would make it a red-letter occasion. Distances were great and settlements small in the Wild West before the days of the horseless carriage, and it was no easy job to get a crowd. Roping contests, the usual fare, were too commonplace; this year something unique was wanted.

One evening, so the story goes, after the committee had argued over many suggestions, the earlier Will Rogers, a local rancher, proposed in a jocular and reckless mood:

"Tell you what, boys, I'll climb the Devil's Tower for you. That ought to bring them."

They laughed at him.

"Neither you nor anyone else can climb that," they said.

Will felt challenged. "What'll you bet I can't? Is it worth your time to watch me try?"

Too late to back out

And so before the night was over, Will Rogers, being a man of his word and having a sizable bet to protect, found himself suddenly projected into the role of a human fly. We can well imagine the anxiety with which he studied the gigantic column of rock, as he tried to plot his climb.

Rising 1280 feet above the Belle Fourche River and 865 feet above the slopes of its foundation, the tower is an almost vertical shaft which appears utterly unscalable. It is formed of great upright columns of rock, mostly pentagonal in shape, though some are four or six sided. Their average diameter is six feet, though they generally taper somewhat toward their tops. Near the summit they slope slightly inward, at an angle of four to five degrees on the west side, and ten to twelve on the east.

The climb up the great slope formed of fallen fragments would be easily accomplished; but scaling the steep cliff would be a problem of a very different magnitude. In the lower quarter or third of the tower the columns tend to merge together to form a massive rock and show but little trace of the columnar structure. Will studied the problem with his associate and mapped out his plan of attack.

From far and wide

The Fourth of July dawned clear and bright, as July days do in that beautiful country. From all points of the compass people came on horseback, in wagons and buggies, and even on foot. Some had been traveling for over a week. Will Rogers' projected ascent of the Devil's Tower was indeed a banner attraction. There was considerable speculation when he appeared carrying a large bundle of wooden pegs and a short-handled mallet. He also had a flag to be unfurled when he reached the top.

The climb began. Quickly surmounting the basal slope, Will selected a place at the foot of the cliff where the crack between two adjacent columns had not opened nor been greatly weathered. The purpose of his wooden pegs then became apparent to those who were watching: Will was going to build a ladder to the summit! It was slow work, driving in a peg, then inching up a little higher to put in another peg, and so on.

But little by little the tiny figure went higher, as the crowd, shocked into silence by the sheer audacity of the undertaking, strained their eyes to follow him. Will's form became smaller, until he looked no larger than a tiny ant climbing the side of a sugar barrel. From time to time he remained motionless, seeming to have reached the limit of his powers. "He'll never make it," said some; others, "Even if he gets up, he'll never be able to see his way back down."

And then he was crawling over the rim. To the accompaniment of great cheering from the gaping crowd below, Will Rogers stood up and unfolded his flag. He had achieved his goal: he had won his bet!

Suddenly a gust of wind caught the flag and carried it up into the air. It floated down almost into the very laps of the picnickers. Nor was enterprise lacking among them. Certain commercially minded individuals seized upon it and were soon selling small pieces as souvenirs of the greatest rock climb the West had ever seen.

An island in the sky

Meanwhile Rogers was exploring the summit before making the descent. He found himself on an almost flat surface, oval in outline and approximately one and one-half acres in extent. It was carpeted with grass, sagebrush, fern, and mosses. Most surprisingly too, he found that he was not the first to make the climb. Chipmunks had pioneered the undertaking and seemed to be flourishing there! How they succeeded in making the climb—and why they did it!—is still a mystery.

If the Devil's Tower looks high from below, it must have looked far higher to Will Rogers as he peered dizzily over the edge. The tremendous mass of rock beneath him has since been estimated to be sufficient for surfacing a sixteen-foot highway nine times around the world. However, he managed without mishap to descend the cliff and was greeted by the noisy acclaim of his wildly celebrating audience. Kegs were broached, and the glory of the feat grew in the telling. Then came the anti-climax.

Surrounded by his friends, swollen with pride and picnic beer, Will was startled to hear exultant shouts in the distance. Yoo-hoos and cat calls were drifting down from the upper regions. Picnickers round about him were saying the equivalent of, "Don't look now, Will, but somebody is on your tower." Will had done the supposedly impossible; had won his bet; had earned the plaudits of his audience. But now his feat had been duplicated by a group of boys! For while their parents had been congratulating their rancher neighbor, the youngsters had become bored and had set out to inspect his ladder. They had inspected it all the way to the summit!

And so it was a saddened Will Rogers who returned to his ranch home that night. His was still the glory of being the first to climb the tower—but that glory had been tarnished a bit by a few mere boys.

But it seems that Will may have recovered sufficiently from that discomfiture to boast about his climb a bit too often at home. At any rate, his humiliation was soon complete; for his wife went over to the tower one day and climbed it too!

In the years that have followed, perhaps 25 persons have climbed the tower. Will Rogers' ladder is now practically gone, and the last two parties to climb received permission to do so only after they had given assurance that they would not disturb any natural features, would use no artifical aids in their climb, and would receive no financial reward for the achievement. The climb is now prohibited because of the hazards involved.

Suddenly, just one year ago, the tower once more became the center of nationwide interest. Once again, its notoriety was the result of a foolish bet. A certain parachute jumper, whose actions do not justify the mention of his name, made a bet that he could jump from an airplane and land on the tower. He was not a mountain climber and apparently lacked even foresight enough to realize the problem he would face when he attempted to descend from the top. The jump was made; and he, too, won his bet. But for several days while he nursed his hunger on the top it appeared that he would not survive to collect his winnings. Finally, however, Dick Durrance and Harry Butterworth, experienced mountaineers who in September, 1938, had made the last recorded climb, voluntarily made the hazardous ascent a second time and succeeded in roping the parachutist down from his perch.

Just what is it about this great shaft that has attracted so much public interest and caused it to be singled out among our natural wonders as our first National Monument, in 1906, by President Theodore Roosevelt? Primarily it is its commanding position on the rolling plains in northeastern Wyoming. An old description says that it "resembles in appearance the stump of a great tree, its surface curiously striated vertically from top to base; and being perched on the crest of a high, flat-topped ridge, it becomes a very prominent landmark, which once seen, is so singular and unique that it can never be forgotten."

The story of its origin

To the student of earth history, the geological story of the shaft is as interesting and as singular as is the appearance of the tower itself. The principal evidence regarding its formation is to be found in the nature of the columns which so prominently mark it. They are composed of a microscopically crystalline type of granitic rock, the only rock of its type in the immediate vicinity. In the hills surrounding it, as well as in the banks of the Belle Fourche River, the exposed formations consist of almost flat-lying beds of bright-colored sandstones. The tower seems to be resting upon them, and they in turn seem to sag downward beneath its weight. Since these sandstones underlie at least a portion of the tower, it is obvious that the molten mass which solidified to form the shaft reached its present position after the sandstones were laid down. And yet, if these sandstones had formed the surface rock at the time, the molten material, working its way up through them, would have poured out on the surface as lava and would, under normal conditions, have cooled too quickly to permit the formation of the columns which characterize the monument. It is, in fact, the size of these which indicates that there was originally a considerable thickness of sedimentary rock lying above what is now the present surface, and that the tower was not forced up into the air in its present condition, but was formed beneath the surface and later exposed.

On a basis of the evidence, the following geologic history of the landmark is offered:

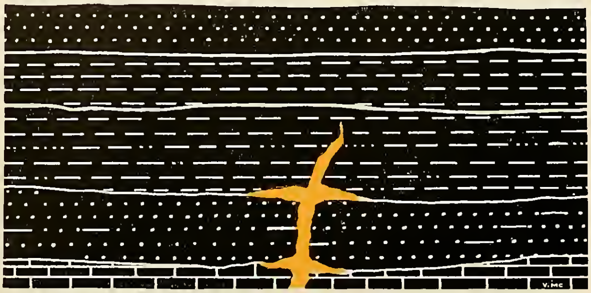
From 40 to 60 million years ago, a mass of molten rock was forced up through the mantle of sandstone, probably along the somewhat pipelike vent. Urged on by the pressure below, it worked its way up through the rock, layer by layer, until at last it came to a layer which resisted its advances so strongly that the molten material was forced to spread out sideways. The strong layer was pushed up into a dome-shaped eminence, and the molten material or magma as the geologists call it, did not succeed in breaking through.

Vertical columns formed in cooling

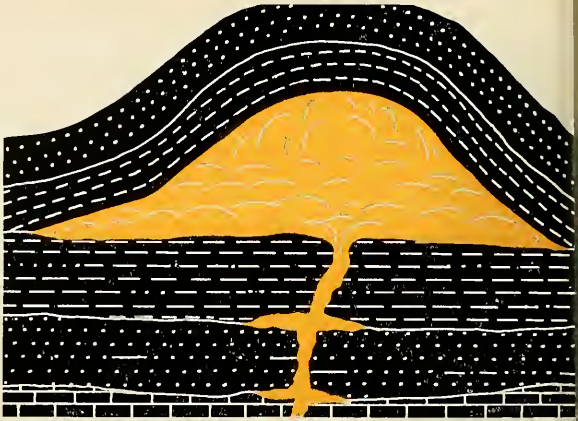
The upper layers of rock acted as a blanket, under which the dome-shaped mass of magma cooled rather slowly into a finely crystallized, granitelike rock. And during its cooling, it contracted and cracked into great columns. The cracks that formed these columns developed much as the cracks do that appear in drying mud, which tend to radiate out at angles of about 120 degrees from one another in a honey-comb pattern. In the cooling mass of rock, the centers of contraction were not all equally far apart, so that the resulting columns are not all six-sided but range all the way from three- to eight-sided.

Columns of this type always form at right angles to the cooling surface, in other words, at right angles to the broadest surface area. Since the columns of Devil's Tower are almost vertical, the greatest extent of the mass of which it is a remnant was therefore horizontal. The columns were formed mostly in the central portion of the mass, because the top and bottom portions, being in closer contact with the cool surrounding rock, lost their heat too quickly to develop columns.

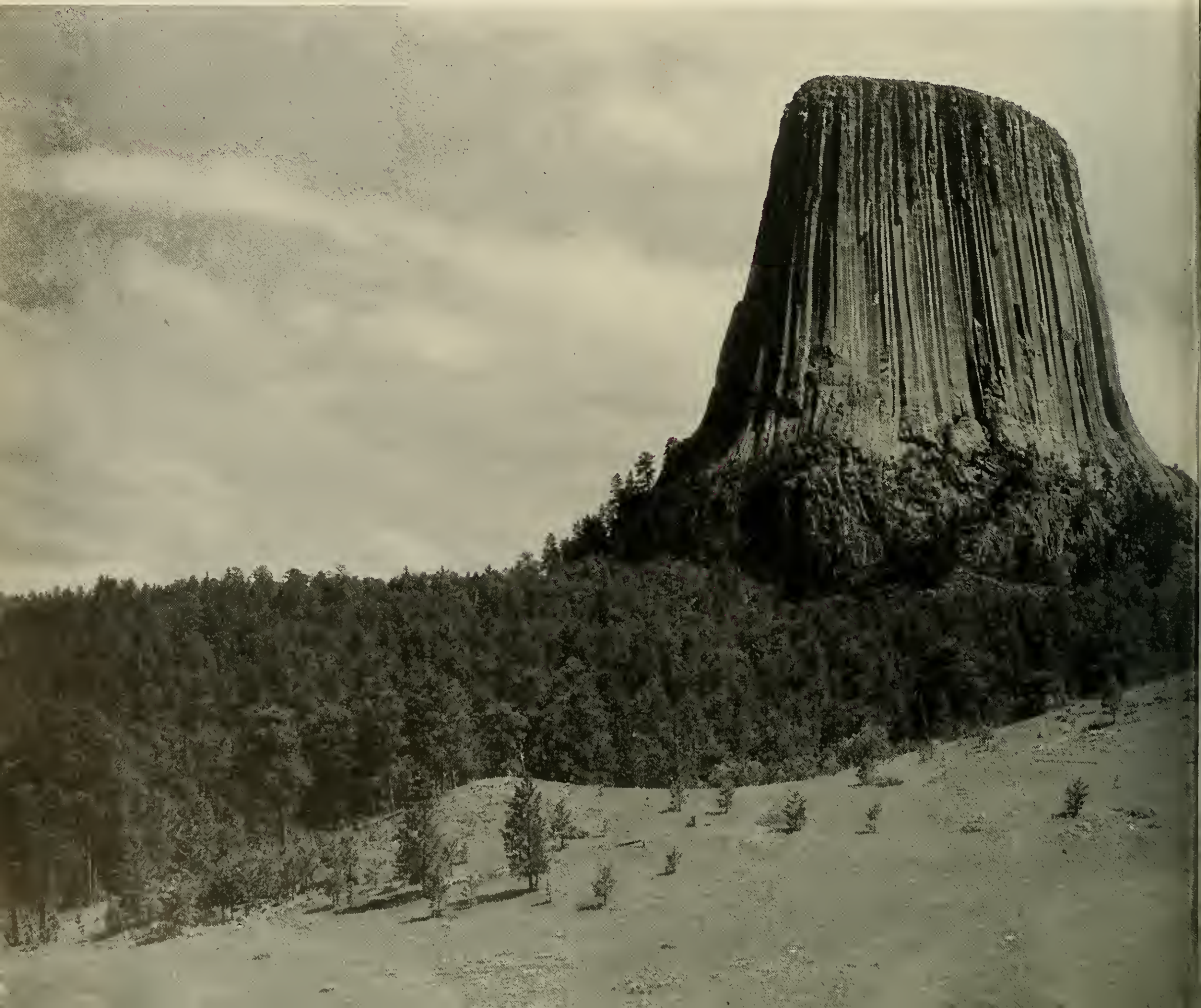
All during this process, the slow but inexorable forces of erosion—rain, heat, cold, wind, etc.—tore at the overlying mantle. At last they succeeded in doing what the pressure behind the magma itself had

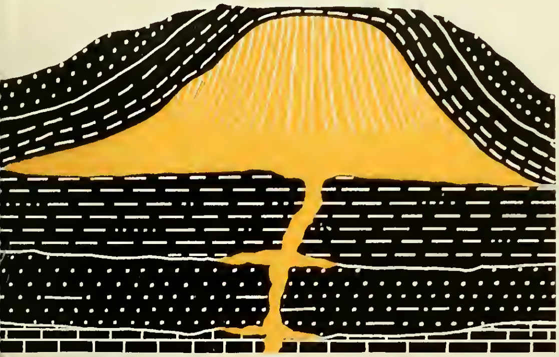


1 How it was formed: Some 40 to 60 million years ago a mass of molten material ate its way up through the mantle of sedimentary rock, as shown above

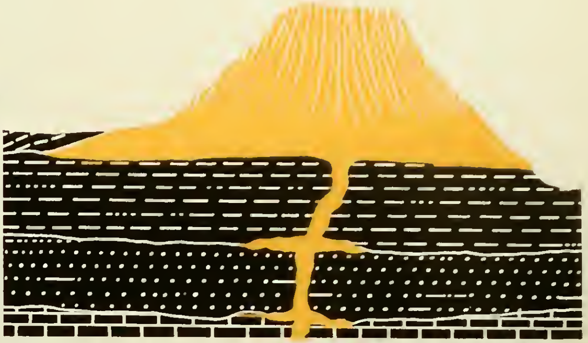


2 Meeting a stronger layer, the molten material had sufficient pressure to bulge it upward but could not break through and therefore spread sideways





3 **The Mass** slowly cooled and contracted, cracking into vertical columns near the center. Meanwhile, the elements were wearing away the surface mantle



Drawings by Victor McIntosh

4 **In time** the mass was exposed, and its sides were in turn eroded by the elements. The harder columnar core has resisted erosion and remains today

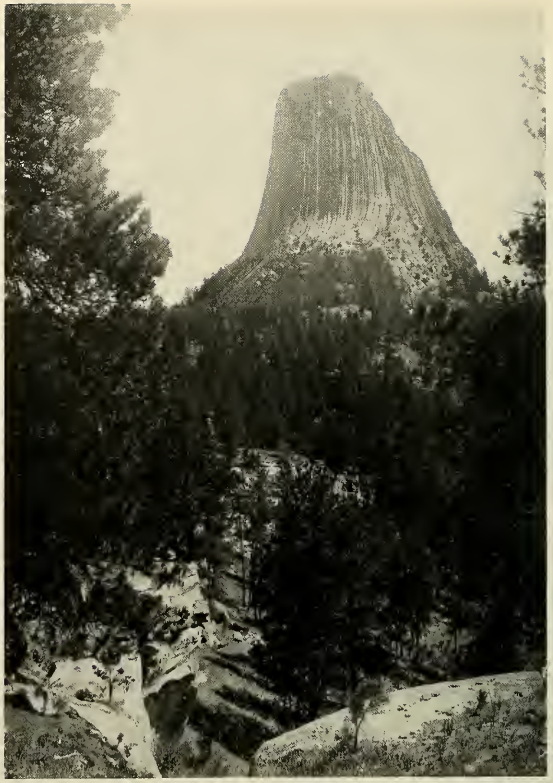
United States Department of the Interior Photo

5 **As a result** we have the slender, towering shaft of Devil's Tower, the last remnant of a once much larger body of igneous rock

▼ **The Little Missouri Buttes.** These neighboring lacoliths are of the same rock as the Tower, but lacking its prominent columnar jointing, they have been eroded as rounded hills

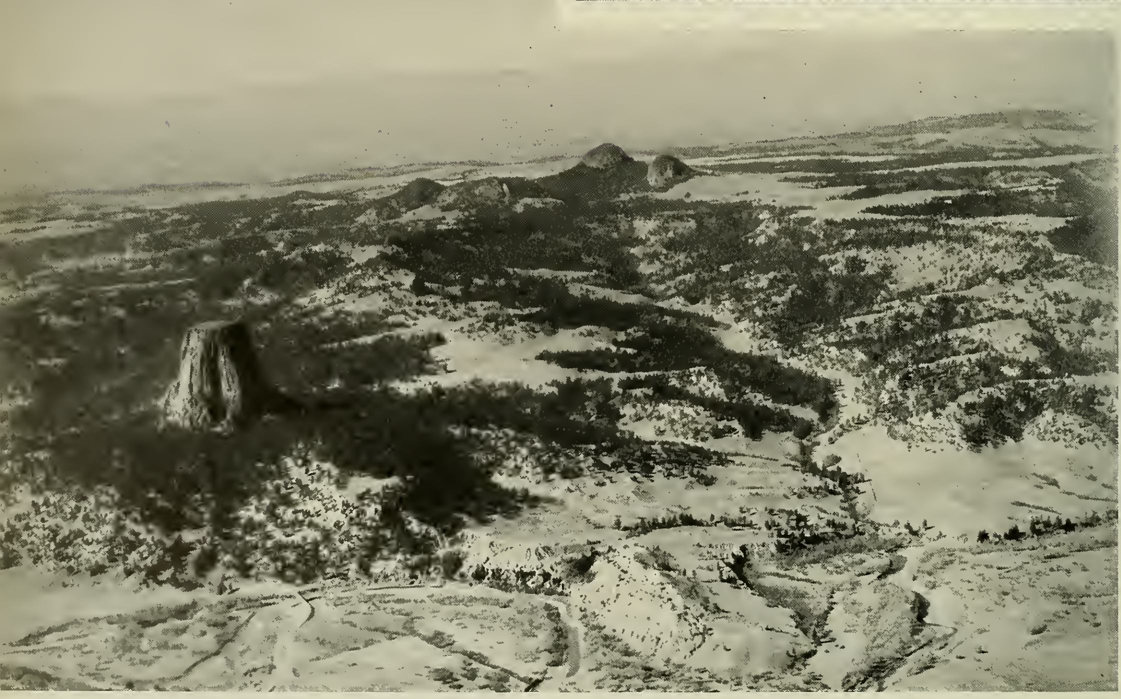
Photo by Albert Thomson

not been able to accomplish—exposing the dome-shaped mass. But the erosion did not stop there. It at once attacked the igneous mass itself and found in the fissures separating the columnar structures an easy means of access. As a result the mass was eroded more easily from the sides than from the top. Finally there remained only a towering central remnant, the tall slender shaft that is our impressive scenic monument, the Devil's Tower,—the setting for Will Rogers' triumph and discomfiture just 49 years ago.



➤ **The Indians** explained the striations on the sides of the tower as the claw marks left by a gigantic bear which tried to catch a maiden who had escaped to the top

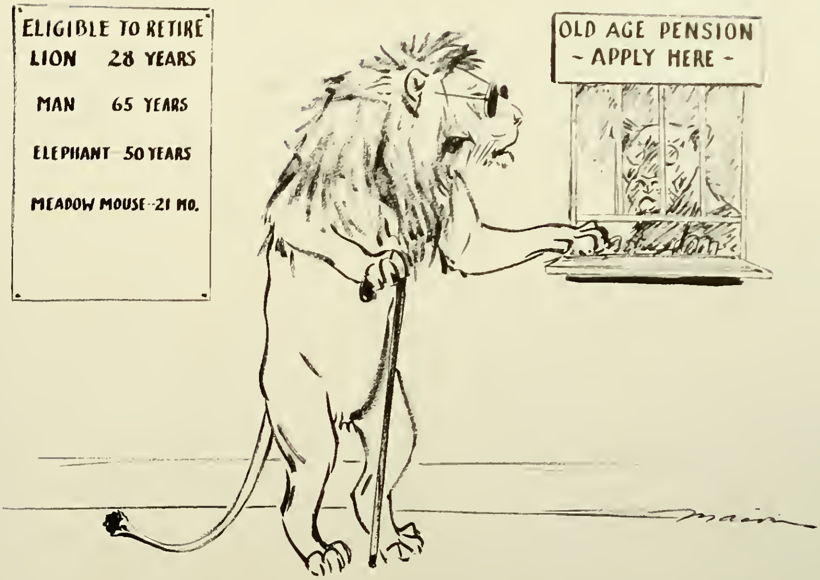
Photo by Albert Thomson



An airplane view shows the surface of the tower —an acre and a half of land seen at close range by but few persons. A mystery still remains as to how chipmunks living there reached the summit—or why they chose to make it their home

Photo by Barnum Brown

OLD AGE IN MAMMALS



By JOHN ERIC HILL

Drawn by

G. FREDERICK MASON

IN the wild very few mammals reach old age. If they are meat eaters, like the lion, a little reduction in the keenness of the senses or the loss of a little vigor or speed, often means that the predator can no longer catch his prey. If the aging carnivore turns to eating carrion, he must compete with a number of "professional" scavengers, and even this way of life may be hard. Many old lions are killed and eaten by the hyaenas. A plant-eater likewise is much more likely to fall victim to a hungry carnivore when age begins to stiffen joints and dull the warning senses than when he is young and vigorous. There is little provision for old age in nature.

This theoretical picture is often confirmed when we collect animals in the wild. Few individuals are secured that are older than young adults, comparable to a man of 25, especially among the small species and the predators.

But although among most mammals this is true, monkeys, apes, and bears often reach a ripe old age, as shown by worn teeth and closed growth-lines (sutures), particularly between the bones of the skull. They may indeed live longer in their native haunts than in captivity. Both bears and monkeys have the ability to eat many kinds of food, so they are not handicapped in this respect by age as are the predators, and they do not have many enemies. Although monkeys may be old, they are not likely to be more than 20 years of age, while an old bear may be 30.

Of all the mammals, man is the one with the longest potential lifespan, but few men reach the age of 65 except under conditions of civilization and in temperate climates, however contrary that may be to legend. In the cartoon the lion is shown to be at 28 about equivalent in age to a man of 65. Few lions in captivity reach that age, and it is unlikely that any do under natural conditions.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Fall, 1942.

WEDNESDAYS over WNYC from 3:30 to 3:45 P. M.

Science For the Seven Million

•

FRIDAYS over the Columbia Broadcasting System from 4:30 to 4:45 P. M.

Exploring Space. Science in the sky.

For many years it was thought that the elephants were very long-lived. Natives and travelers told of elephants hundreds of years old, but when actual records were kept the oldest one that could be found was about 60, and very few were 50. But even if the elephant can no longer be given first place in age, he may properly be accorded the second.

Whales were long the subjects of much speculation. Some thought they must live a very long time to reach such a large size. All of the studies in recent years, however, show that only twelve years is required for the largest whale to grow up, and none were found much older than that.

Small rodents are among the shortest lived mammals. Our common meadow mouse rarely lives more than 21 months, almost invariably dying in the second winter of its life. The small, sharp-nosed shrews live only about the same time, finding the age of more than a year too great a handicap in winter.

THIS PREOCCUPIED FLORIDA CRANE closely resembles the sand-hill cranes that are becoming more numerous in regions to the north

(From an American Museum group, photographed by C. H. Coles.)

THE FLYING CROSS

By GRACE V. SHARRITT

Wise conservation laws and a sympathetic public are rescuing a magnificent bird from near extinction

WHEN winds are high, and rains flood the muddy bottomlands, the sand-hill crane appears upon the spring and fall horizons. Flying with head extended and drooping legs through the blue October sky, he has gained for himself the name of Flying Cross. His only herald is a weird, trumpet-like call, echoed when he sights his resting ground. Smoky-colored and standing almost as tall as man, he makes an odd appearance, for his plumage is so distributed that he appears to be wearing a feathered Victorian bustle and a brief red skull-cap.

The sand-hill crane in the past has been a fast diminishing race, but owing to state and federal laws of conservation and a wide-awake public, the bird is slowly increasing its numbers. It is within the past five or six years that this increase in the crane census has begun to assume favorable proportions. From scattered areas throughout the land, isolated reports identifying the bird have come in to state conservation departments and federal reservations.

There was the farmer who told how he was shocking corn in a southern Michigan farm when he saw a flock of six greyish-tan birds walking slowly along the fence of his cornfield. He had never seen anything like them in the 20 years he had been plowing his farm. He stood in silence as long as he could, watching the grotesque looking birds feed on the dropped corn. Then excitedly he called to his son across the road, "Come here, John. Hurry! There's the dangest looking ostriches." At the sound of his voice, however, the cranes lifted their huge bodies from the ground and formed their flying crosses against the sky. Not one person out of 50 or 100, it has been estimated, has ever seen a sand-hill crane in the wild, yet here was a Michigan farmer within speaking distance of a flock of birds so rare that he didn't know their names.

On a spring morning, a fisherman was surprised

Photo by Bernard W. Baker

▲ As THEY APPEAR when rising to form flying crosses against the sky: sand-hill cranes wintering in a rice field near Houston, Texas

to see a sand-hill crane feeding on roots or crustaceans in the mud of the bank. He knew it to be a sand-hill crane, for as he wrote in *Outdoor Indiana* (the official publication of the Indiana State Conservation Department): "All my kid life I'd heard my mother talk about sand-hill cranes. To me they was something that jest never would be seen agin. They was goners with the Kankakee marshes and the old beech woods when the trees got water and nourishment enough to make beechnuts for me . . . sand-hill cranes was gone with the wild pigeons . . . with the deer and panthers."

The life-story of the sand-hill crane has a pattern similar to that of many of the pioneer American game and non-game birds, moving from one of overabundance almost to one of extinction. Formerly the crane bred from British Columbia, Saskatchewan, and southwestern Michigan south to California, Nebraska, and Ohio, and in migration east to New England.

It is now rare east of the Mississippi; its southern range is practically erased. It still breeds from northeastern California, Texas, and Louisiana, south to Mexico. Laxness in game law enforcement (cranes are excellent to eat), and the draining of the marshlands throughout the Midwest, are the main forces working against the crane.

The marshlands are positively essential to the propagation of the bird. The cranes do not tend to have large families—in fact, they just about manage to carry on their strain. The female bird lays two greenish-brown eggs in a nest made from grasses, weeds, roots, and mud. The crane is well able to protect itself. It will avoid man, but when cornered, is extremely wary. When, by the 1930's, the cattail marshes and muddy flats of duck weeds and swamp grasses of the Midwest were destroyed to make way for the widening of steel mill districts across the prairies of Illinois, northwestern Indiana, and parts of Ohio and Michigan, the birds moved farther and farther into the remote swamps and regions of northern Michigan, Canada, Minnesota, and the Dakotas. The crane needed encouragement to increase, instead of destruction of its nesting ground. Fortunately the government stepped in to help preserve the bird.

Each autumn as their tribe grew alarmingly smaller, Mom Crane, on the day of their take-off from the North to the South might well have said to Dad in *Grus canadensis* language. "Well, Sandy, do you think we can make it to Texas? The hunters are better shots each season."

"Yep," the old man might have answered, rolling a weather eye to the sky. "The boys do seem to aim surer. But cheer up, maybe the game wardens will help us through."

The state and federal game wardens, coupled with a greater public interest, have increased the lifeline of these cranes, which are cousins to the Florida little brown cranes. Marshlands are coming back in some areas, and where this miracle occurs through established reservations or legislation, more frequent reports of the appearance of the crane come in. These Flying Crosses are among the highest flying of all birds. Many an aviator has been thrilled with their cross formation a mile above the earth.

Out in the Red River Valley in the last two years, Flying Crosses have been observed in numbers from 500 to 600, winging south in the fall. The amazed farmers appealed to the game wardens for advice on how to deal with the birds that made a cross in the sky above their cornfields.

For the most part, however, farmers and countrymen are so interested in the presence of these remarkable visitors from the airlanes that they welcome them. At least that theory holds true in Michigan. The farmers in that state get a real kick out of watching the rare, cautious cranes that tarry to rest and feed upon grains, grasshoppers, and other insects in their fields. The countryman is proud to interview ornithologists and scientists who travel great distances to observe the crane. In fact, Michigan has become so sand-hill crane conscious that the State Audubon Society, in October, 1941, established the only sanctuary in the United States devoted primarily to the study and research of the bird which makes a Flying Cross when taking to the air.

▼ STRUTTING AND BOWING on a stubbled corn field, this male crane tries to attract a mate

Photos by Bernard W. Baker

◀ ONLY two eggs are laid in the marsh-hidden nest. Destruction of nesting grounds through "land improvement" has threatened this bird

YOUR NEW BOOKS

ALASKA ● EDWARD SYLVESTER MORSE ● FADING TRAILS
STRATEGIC MATERIALS FOR DEFENSE ● SUN CHIEF

EDWARD SYLVESTER MORSE

- - - - - - - by Dorothy G. Wayman

Harvard University Press, $4.50

WE have here the life story of perhaps the most outstanding American example of a man whose long scintillating scientific career rested almost entirely upon sheer native ability. Morse, who was born in Portland, Maine, in 1838 and who died in Salem, Mass., in 1925, put himself down as a specialist in zoology, ethnology, and Japanese ceramics, and there is ample testimony that he made substantial contributions in each field. In addition, it now appears, he was also a clever illustrator, an inspiring teacher, a widely appreciated lecturer, a thundering civic reformer, a modest inventor and, for the last 45 years of his life, the director of the Peabody Museum in Salem.

The author, from voluminous diaries, letters, etc., has conjured up a dynamic personality, acceptable in the main, no doubt, to those who knew Morse. The reader will meet a somewhat egocentric but likable person who as a boy was expelled from every school attended, who rebelled against his father's religion, who worked only fitfully at anything remunerative, but who from the age of twelve roamed the forest and seashore collecting shells. This hobby he pursued so effectively that Professor Louis Agassiz of Harvard University, in 1859, engaged him as student assistant in the newly opened Peabody Museum. Strangely enough, this contact, involving both formal and informal instruction from the beloved teacher, lasted only two years; but it supplied inspiration sufficient to keep the pupil going for life.

During the next fifteen years Morse gradually attained his stride in research, teaching, and lecturing. Then, in 1877, he went to Japan to study brachiopods but remained to establish the teaching of zoology, to initiate archaeological research and to gather, for himself, what in time became the world's most notable collection of Japanese pottery, now in the Boston Museum of Art. In the meantime he published several volumes of observations on life in Japan and in China—even one on life on the planet Mars! His pet ethnographic subject was that of arrow-releases. But, after an excursion of 20 years or so in anthropology, he once more turned his chief attention to zoology.

The book and its subject deserve more space than is here available. Let it suffice that Morse was showered with honors and that he retained his youthful characteristics to the end. He lived as he worked, with gusto, enjoying life to the full. The last time I saw him he was still playing his nose flute.

N. C. NELSON.

LORD OF ALASKA:

Baranov and the Russian Adventure

- - - - - - - - - - - by Hector Chevigny

The Viking Press, Inc., $3.00

TO many residents of Alaska and to most of its tourists, Baranov means simply the name of Alaska's de luxe hotel in Juneau. One hundred and thirty years ago, however, the same name was one to conjure with in the affairs of the Pacific. Time had, indeed, obliterated at the very scene of his labors all but a trace of the man who for 28 years had struggled to create an American empire for Russia. From this long neglect Hector Chevigny has resuscitated the fame and career of Aleksandr Andrevich Baranov, not as a phony literary exercise but as a vital and significant phase of the discovery and exploitation of the Alaskan empire.

Baranov was the son of a modest merchant family and was 43 years old before he was selected to go to Kodiak Island, Alaska, in 1790 as the representative of a Russian firm trading in sea otter skins.

These skins, highly prized in the Chinese market, were abundant along the Alaskan coast and formed a most profitable item of commerce.

For the next 28 years Baranov labored faithfully and shrewdly for his employers and for Russia. Against incredible odds, both of human and geographic origin, he struggled to maintain a precarious toe hold on a vast empire and a lucrative business. Most of the time he was hampered by lack of support both from his employers and his government, although belatedly his merit was recognized by an appointment as Governor of Alaska.

At the end of his career Baranov could calculate the material profits he had won in the millions of rubles. He could point to 24 separate settlements he had established. Upon him depended a population of nearly 10,000 souls. But more than these he had created an empire.

Mr. Chevigny has admirably recounted the fascinating story of this individualistic pioneer, whose prize was dissipated by incompetent successors and bureaucratic governments. The story is far more than a local incident in Russian history. It is also a part of our own.

H. L. S.

The dramatic story of endangered American wildlife

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THIS BOOK will stir you to action! The wanton destruction of our wildlife has been a shame and a tragedy. Here, you can read not only the stark story of the animals we have lost, but also the full account of those in danger of vanishing. Written by outstanding authorities.

"Whether for facts or for challenge, this book belongs in every American home."—*New York Times.*

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Beautifully illustrated—4 in full color; 20 black and white photographs; 12 line drawings.

279 pages $3.00

MACMILLAN
60 FIFTH AVE.
NEW YORK, N. Y.

SUN CHIEF, *The Autobiography of a Hopi Indian*

- - - - - - Edited by Leo W. Simmons

Yale University Press, $4.25

THIS life story of an Indian was prepared by Doctor Simmons of the Department of Sociology of Yale University and published for the Institute of Human Relations. It is an intimate account of 50 years in the life of Don C. Talayesva of Oraibi (born in 1890), told in the first person, and it is as frank as the autobiography of Cellini.

The reader is likely to be surprised at Don's photographic memory, but his recollections ring true and are most convincing. Unbiased truth and frankness are rare in autobiography, but here is one of the exceptions. The material was gathered during many interviews and from a very extensive diary that Don kept in long-hand under the direction of Doctor Simmons.

Until he was ten, Don was reared as a

Hopi boy, and the first four chapters of the narrative are devoted to his childhood experiences. "We children were never denied food, locked in a dark room, slapped on our faces, or stood up in a corner those are not Hopi ways."

When about ten he went to school on the reservation, and tried to learn the white man's way under the direction of white teachers. Later he attended the Indian school at Riverside, California, where he learned to "talk like a gentleman, read, write, and cipher." He could name all the states in the Union with their capitals, repeat the names of all the books in the Bible, quote a hundred verses of scripture, sing more than two dozen Christian hymns and patriotic songs, debate, and shout football yells.

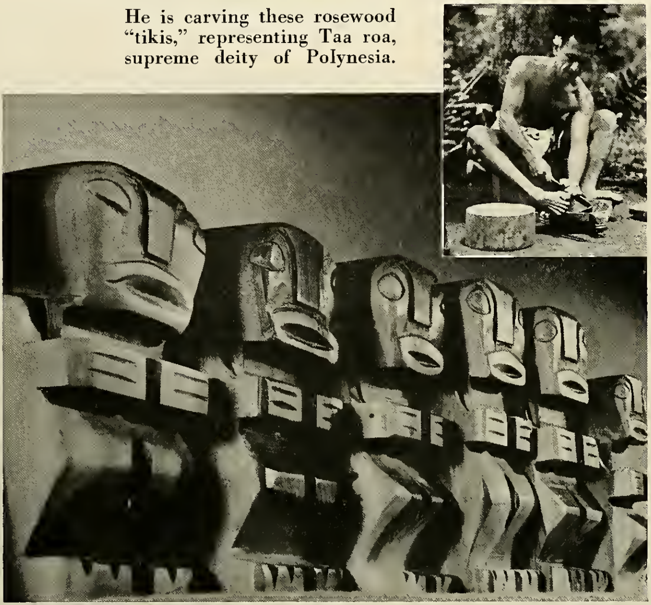
At about 20, he returned to the Hopi Mesas, renounced Christianity, which he had accepted superficially, joined secret societies, worshiped the rain gods in elaborate ceremonials—in short, returned wholeheartedly to the old Hopi way of life.

The editor of this book, a white man, was adopted as Don's clan brother, which adoption improved his status in the village and made it appropriate for him to be instructed in some subjects which were regarded as clan and tribal secrets. This is not only an absorbing autobiography of one of our native Americans, but it has the added value of being a real contribution as a sociological and personality study.

CLYDE FISHER.

This is TIARE *of* TAHITI ↓

He is carving these rosewood "tikis," representing Taa roa, supreme deity of Polynesia.



They were brought to us across the Pacific on the last boat from the peaceful South Sea Islands of Tahiti, Samoa, Rurutu, Nuka Hiva. There Mr. Martin Anthony Brunor assembled this unique collection of figures, polished wooden bowls, and other carvings, both beautiful and grotesque, representing a fast fading native art.

Impossible to duplicate, and outstanding for their strong primitive workmanship—and for the handsome grain of the rosewood, mahami wood, and rare cordia subcordata wood—we are proud to offer these fascinating pieces at amazingly low prices.

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5½ inches high by 1½ inches wide	$1.25 each
6½ inches high by 1¾ inches wide	$2.00 each
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Oval bowls approximately 8 inches wide and 16 inches long vary in price from $3.00 to $8.00, according to workmanship.

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White pikaki shell necklaces, each with more than 700 shells, $1.00 each plus 10c excise tax.

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Pairs of baby giant (tridacna) clam shells, approximately 9 inches long $5.00 a pair.

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Kindly include 10 cents postage for each wooden carving or pair of shells. No postage for necklaces.

The BOOK SHOP

American Museum of Natural History, 77th Street and Central Park West, N. Y. C.

WILDLIFE OF IDAHO

by William M. Rush

The Caxton Printers, $1.00

Wildlife of Idaho is a compact book on the mammals, birds, and fishes of that state, written by the author of *Wild Animals of the Rockies,* reviewed in last month's NATURAL HISTORY. The book is intended for use in the schools, for teachers of the lower grades and for pupils of the middle grades. The undertaking is praiseworthy and much of it has been well done. The language is simple, and technical terms are explained when the author feels obliged to use them. Special care was taken to try out parts of the book as to suitability and interest.

Interspersed with the descriptions and explanations of relationships of the animals are stories of hunting, adventures of animals and their development, told with evident sympathy. It is unfortunate that in a number of places the author taxes credulity: a beaver-hunting otter, geese trapped by street lights, an eagle that crashed into a treetop. Needless and undesirable complications were introduced in several places by describing subspecies, here called as often as not "species." The general effect of the book should be to encourage youngsters to study and enjoy the wild things about them, and to implant an interest in conservation.

The book is illustrated by numerous photographs, including a number in color. Some of these latter are not very good whether due to the originals or the reproduction. The black and white photographs of live animals are good, and are a valuable part of a book like this.

JOHN E. HILL.

STRATEGIC MATERIALS IN HEMISPHERE DEFENSE

by M. S. Hessel, Walter Murphy, and F. A. Hessel

Hastings House, $2.50

SINCE our government has not as yet felt the necessity of explaining to Mr. John Q. Public, as the authors too often dub him, the necessity for the curtailment of many products that he regards as practically his constitutional right, an explanation from unofficial sources is very welcome. This book endeavors to tell why many materials are regarded as strategic and critical, where, how, and how much of each is used, what the prospects are for filling that demand, and where the shoe may next pinch.

The first section on rubber and its synthetic substitutes is very enlightening. Successive sections deal with strategic and critical mineral materials, organic products, such as oils, fats and gums, chemicals, petroleum, and so on. A brief section discusses the Latin American countries and their exports.

The work is well documented and contains an excellent bibliography. The salient statistics of production and consumption, using the most recent figures available, are listed after each discussion. The closing summary points out some fine morals about the conservation of our waste materials and of our scientifically trained brains—both irreplaceable when time is such a vital factor.

The authors are chemists, and their knowledge of minerals appears to be limited. The book could advantageously have been made a little longer, with more complete explanations of the uses of many of the materials and more information about them. One suspects that the "Frary metal," which it is said may relieve the antimony situation, may itself take metals needed for other equally essential uses. Any explanation of our present critical situation is very welcome, and here one will find not only the important facts but a handy summary of statistics and a reasonable explanation of governmental actions that superficially appear without justification in need. The WPB could profitably quote from some of these sections when they decide that shoes or woolen clothing or soap must be added to the ration list.

F. H. POUGH.

NEAR HORIZONS

- - - - - - - - - by Edwin Way Teale

Dodd, Mead & Co., $3.75

TO readers of NATURAL HISTORY Mr. Teale is no stranger, for his remarkably detailed pictures of insects and no less vivid accompanying text have contributed to the attractiveness of several issues of this magazine. The present volume records with spirited imagery the observations and adventures of a stay-at-home explorer whose Long Island garden has been planned not as a horticultural show-piece but as a lure and place of settlement for insects whose life histories he is eager to investigate. Yet, restricted territorially as this field of observation is, it produces—as the book abundantly evidences—creatures more bizarre in structure and more diversified in habit than the giraffe, the musk ox, the armadillo, and the kangaroo, to observe which in their natural environment one would have to range over a considerable part of the globe.

The book is written with zest. Even a reader to whom insects are only "bugs" will find it difficult not to acquire a new attitude toward these six-legged wonders under the spell of Mr. Teale's animated observations. But let no one be under the illusion that the volume is emotional at the expense of much substantial information. Patience, ingenuity, tireless energy, and an inquiring mind—not to mention wide supplementary reading—were required for the groundwork. A single short sentence—that in which the author records a cattail head as containing 147,265 close-packed seeds—required night after night of diligent counting to assure accuracy. The 160-odd pictures—many of them in series showing significant stages of a given insect's life and most of them masterpieces of insect photography—were culled from more than 10,000 photographs taken by the author.

The book supplements Mr. Teale's popular *Grassroot Jungles,* also mainly a home-site record of entomological observations.

HERBERT F. SCHWARZ.

CLIMATE MAKES THE MAN

- - - - - - - by Clarence A. Mills

Harper & Brothers, $3.00

OUR readers will accept this book with a challenge. It presents an astonishing wealth of information on climate, including unexpected coincidences that bear on important changes in human life. The reader may already know that extreme fluctuations influence human life, but the author will also show him that even relatively small changes modify health and bodily vigor, and disrupt the affairs of nations. The ideal habitat is the temperate zone, but not just any part of that zone. In fact there are at present in the whole world only a few restricted areas which are capable of producing vigorous populations.

The upper half of the Mississippi Valley is regarded as the best habitat in the New World; this is the region of greatest fluctuation in temperate climates, suggesting that variety in climate is the important feature. However, it is estimated that a 10° F. rise in the temperature of the world would make most of the tropics uninhabitable, and that a fall of 10°F. would bring down upon us another Ice Age.

Long range fluctuations within these limits are believed under way still and do from time to time shift the areas of most favorable habitat, thus changing national dominance and revamping the course of history. There are interesting chapters on climatic problems relative to the success of the war. Other chapters deal with the individual's problem in selecting a climate to prolong life. In the matters of eugenics we read that the optimum time for conception is December to March.

The statements that changes in temperature precede revolutions, declarations of war, and changes in government may well raise doubts in the minds of our readers. Perhaps the logic of interpretation is carried to an extreme, but the book is worthy of serious consideration.

C. W.

FADING TRAILS

- - - Prepared by a Committee of the United States Department of the Interior National Park Service—Fish and Wild Life Service

The Macmillan Company, $3.00

AN interesting story of wild animal life can be certain of a good audience. Conservation of wild life is an important theme, too, but not always so certain of a

Continued on page 223

NEW BOOKS *from* HARPER

BIRDS ACROSS THE SKY

By FLORENCE PAGE JAQUES

With Illustrations by
FRANCIS LEE JAQUES

"An estimable book so filled with the pure delight of observing and knowing birds of all kinds that it is a joy to read. The fresh breezes of the out-of-doors play through the book." — *N. Y. World-Telegram.* By the author of *Canoe Country* and *The Geese Fly High.* $2.50

TRAIL OF THE MONEY BIRD

By DILLON RIPLEY

Here is a 30,000 mile schooner voyage of humor, adventure, personalities and scientific bird lore expertly blended in a fascinating book. The author tells in delightful detail just how he collected specimens of exotic birds. Illus. $3.50

WILD ANIMALS of the ROCKIES

By WILLIAM MARSHALL RUSH

A U. S. Forest Ranger tells the exciting and personal story of his experiences with bears, deer, elk, moose, antelope, mountain sheep and goats. A chronicle rich in wilderness lore and remarkably detailed observation. Illus. $3.00

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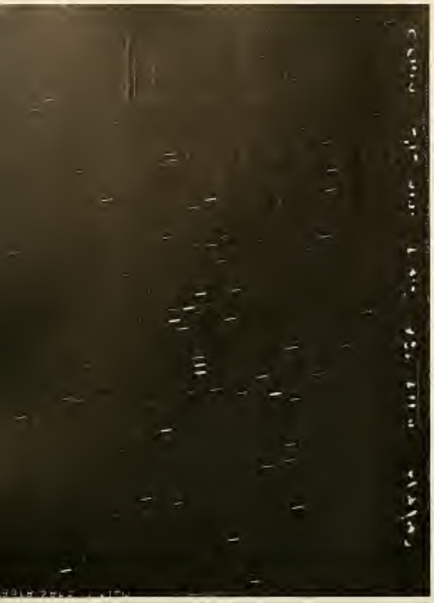
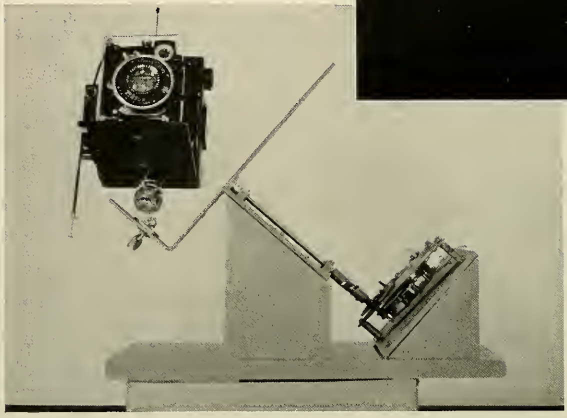
ALL STAR PICTURES



Photos by the author



Because the stars rise and set like the sun, a 2½-minute exposure of Orion produces the unsatisfactory streaks shown above. To show the stars as points *(opposite)*, the camera must be made to follow them by means of a clock-work mechanism such as the one at right, constructed by the author. Invisible stars then appear

By Charles H. Coles
Chief Photographer, American Museum of Natural History

As the air becomes sharper and clearer with the approach of winter, the stars take on a sparkling brilliance that they lack in balmier weather. Their scintillating constellations forever challenge the photographer to reproduce them in pictures. Furthermore, comets, planets, and stars that are not visible to the naked eye are grist for the astronomical camera.

The principal problem to be solved before star pictures can be made successfully is connected with the motion of the stars across the sky. A mechanical method of causing the camera to follow the stars will obviously be more satisfactory than attempting to do this by hand, although good pictures have been made by the latter method. A simple equatorial camera mount with automatic clock drive was constructed by the author and is herein described:

The first requirement is that the camera be mounted on an axis of rotation that is aligned parallel to the earth's axis. This necessitates a shaft tilted at an angle equal to the observer's latitude. The latitude of New York City is almost 41°, so the shaft on the author's equatorial points upward at an angle of 41° from the horizontal. Two simple bronze bearings allow the shaft to turn freely. A collar clamped to the shaft and resting against the upper bearing acts as a thrust bearing to support the weight of the camera.

The camera must be attached to the shaft in such a way that the prolongation of the shaft passes through the center of gravity of the camera. This permits the shaft to turn completely around with the least effort on the part of the driving clock. An L-shaped bracket made of strap iron did the trick. Holes were drilled all along its long side so that the balance point could be found by trial. A universal ball joint attached to the short side of the "L" permits the camera to be turned in any direction once it is balanced, so that different constellations may be photographed. If necessary, a weight may be attached to the other end of the "L" bar to balance the camera.

A small universal joint connects the shaft to the clockwork, so that perfect alignment is not necessary. The clockwork requires a note of explanation:

The stars, rising in the east and setting in the west, complete one revolution about the heavens in four minutes less than 24 hours, so the shaft of the equatorial must make one revolution in the same time, in the same direction. The hour hand of an ordinary clock makes one revolution in twelve hours, so a reduction must be introduced to slow its motion down to half this speed. A set of 2-to-1 gears may be used for this purpose, or, simpler, a 2-to-1 pulley drive. The author managed to secure a clock movement that originally drove the chart in a recording thermometer, and since the chart made one revolution in 24 hours, no reduction gear was required.

The complete equatorial is mounted on a board eighteen inches long, and in use it is clamped to a stool. The base of the equatorial is leveled carefully with a carpenter's spirit level. The main shaft, or polar axis as we may now call it, is pointed at the North Star as accurately as possible.

In some locations—for example, close to the south side of a building—the North Star cannot be seen, so a magnetic compass is needed for orientation. The magnetic variation must be taken into account, however, because this may amount to as much as 20° and so throw the equatorial out of proper orientation. At New York City the needle of a compass points about

11° west of true north. By checking the compass on the North Star, the variation may be found sufficiently close for practical purposes. Be certain that the steel shaft of the equatorial is not close enough to the compass to add an extra error.

If a certain location is found to be a favored one for photographing the heavens, a true north-and-south line may be laid down permanently, so that the equatorial may be aligned quickly at any time. The author has marked such a line on a window sill where the equatorial is often set up. This north-south line was determined in the following way:

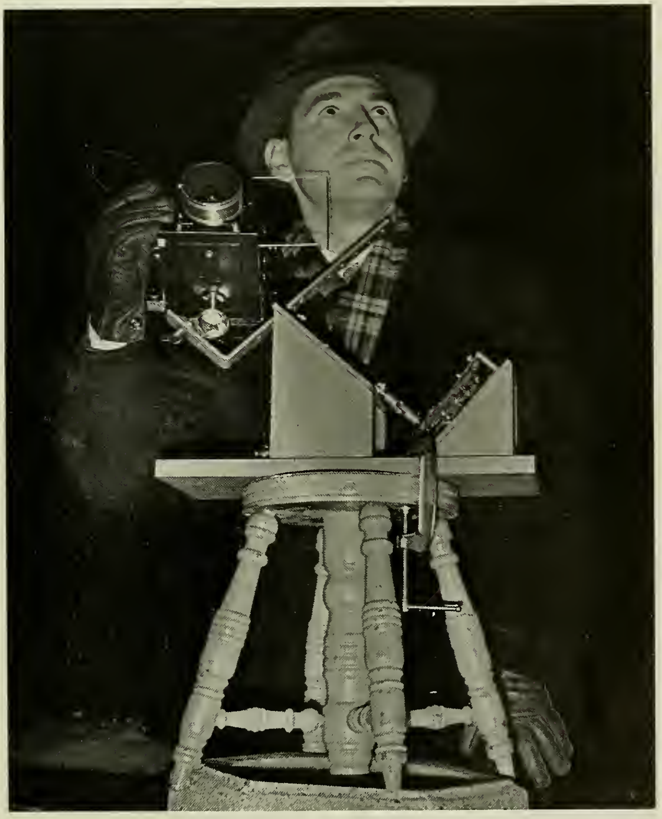
The equation of time for the sun was looked up in an almanac for the particular day upon which the line was to be established. This figure tells how far the sun is ahead of or behind a clock running on Eastern Standard Time. A correction, in this case of –4 minutes, had to be applied because the author's house was 1° east of the 75th meridian. By watching a clock that had been set by radio, the author then knew the moment the sun was directly south—the moment at which a sundial would register noon. The cord of a plumb bob casts a shadow directly north and south at this time. Two pins were pushed into the window sill at this moment along the shadow of the plumbline. The two pin pricks were later connected by a line.

	hr.	min.	sec
Sundial Noon	12	00	00
Equation of Time for November 3, 1942 (subtract)		16	22
Correction for location 1° east of 75th meridian (subtract)		4	00
Eastern Standard Time of Sundial Noon	11	39	38

When taking pictures of the stars, keep the exposure as short as possible to reduce any error that inaccuracy in the clock drive may introduce. Use, therefore, the fastest film available and open the lens to the maximum extent. With a Superpanchro Press film, the author uses an exposure of five minutes with an aperture of f/4.5. Because of the glow in the city atmosphere, a longer exposure might result in fogging the film and would reveal no fainter stars. In this five-minute exposure, stars of the eighth magnitude are readily photographed. Thus, many stars invisible to the naked eye are recorded, for it is only possible to see stars of a magnitude of six or six and a half.

Recording faint celestial happenings with such a camera is a novel experience for the photographer who likes to dabble in the infinite, and a little practice should bring very satisfying results.

NEITHER TELESCOPE nor telephoto lens is needed to penetrate the heavens beyond the range of the naked eye. The drive shaft must lie north and south



ALL STAR PICTURES

INFORMATION TEST

A few informational high spots that may be gleaned from this month's NATURAL HISTORY

Correct answers on page 224

1. What country produces practically all of the quartz available for vital war use?

2. What animal carries its young on its back, can be very much alive when it looks dead, and has a pouch?

3. What well-known household chemical was named after the ancient temple of Ammon-Ra in Egypt?

4. Which is larger, the rhino or the hippo?

5. Because she spun and worked upon a single thread, a good maiden lady was called a —.

6. The summit of the Devil's Tower, in Wyoming, is devoid of life.

True......... False.........

7. Man is the longest lived mammal.

True......... False.........

8. It takes 23 baby opossums to weigh as much as

(a) a penny

(b) a pound

(c) an adult opossum

9. What famous grass widow of history could tell a good yarn as well as spin one and unraveled at night what she had done during the day?

10. The rhino's main weapon is

(a) bone

(b) horn

(c) hair

Answers to Qestions on pages 192 and 193

1. No, a rope on the ground is no obstacle to a snake.

2. Natives of the Congo say that when elephants are feeding on bananas, the diminutive banana mice run through the trunk and strike terror in the elephant. But this is really ridiculous, for an elephant is scrupulously careful about getting foreign matter in its trunk. The interior passage is very sensitive, and if a mouse accidentally did get in unseen, the elephant would certainly blow the little rodent out with tremendous force before it had entered more than a few inches. Eddie Allen, a well-known elephant expert, once trained one of his animals to pick up a mouse on (but not in) its trunk.

3. Snakes are not endowed with any understanding of suicide as a means of escape from difficult problems. So far as is known from limited experiments, venomous snakes could not as a rule commit suicide if they wanted to, because they are to a large extent immune to their own poison.

4. This story usually gains color by the supposition that enormous stores of valuable ivory tusks may be found in the places the elephants have made into graveyards, but nothing like an elephant graveyard has ever been found, and there is no basis whatever for this belief.

5. Yes, it is entirely possible for the horned toad to squirt blood from its eyes. The eyes bulge in their sockets when the animal performs this astonishing and awe-inspiring feat, and there is a distinct sound, likened by Ditmars to that produced when one presses the tongue against the roof of the mouth.

6. Chameleons do change color when angry or afraid or under the influence of sudden changes in light and temperature; but a change is not influenced by the shade of the object upon which the reptile rests.

ROWDY

A Fox that lived in two worlds

When I was teaching science at Berkshire School in Sheffield, Massachusetts, I had the crazy luck on April 3, 1941, to capture a baby red fox simply by stalking it at its den. He was only a few weeks old and was the most appealing little ball of fur imaginable. He drank milk from a saucer, yelped most of the night, and showed real imagination in placing his puddles.

But, a fox as a house pet? The faculty shook their knowing heads. "He'll never live." "You can't housebreak him." "He's certain to become vicious." I named him "Rowdy," put a box of sand in each corner of my room, and crossed my fingers.

By the middle of June I had a real fox on my hands and one whose devilish cunning could no longer be taken lightly. Though housebroken as long as the world pleased him, he was fundamentally a nonconformist. He spent most of his time in my room where he could sit in the sun, peruse my personal effects, tear a towel or two, or simply rest between rounds. His play was constant, well meaning, and murderous. If he had not been loved, he would certainly have been throttled on a dozen different occasions.

At the close of school I shut my eyes to a $25.00 offer for Rowdy and decided to return him to nature. I carried him in my arms to his old den on the mountainside and there released him, certain that I would see but a flash of his red tail as he went out of my life forever. Instead, bless him, he followed me nearly a mile back to school, necessitating a return trip to locate him at his den.

As Rowdy lacked a mother's training, many thought he would not be able to fend for himself, but from watching his play I knew that his instincts were all he needed. His safety was further assured by the fact that this particular area was a game preserve. During the next few days I visited him regularly at his den, taking him food and watching him romp for an hour or so.

When I left him for the last time, he sat motionless beside his den, seeming to understand as he watched me slowly going away from him.

I did not visit school again until the middle of the following September, two and one half months later. Rowdy had not been seen since June, but foxes had recently been taking food left for them behind the stables. Early in the morning the music master and his wife took me to the spot. For a few minutes we stood watching and conversing in low tones.

Suddenly a red fox appeared at the edge of the woods! Could it be Rowdy! With hamburger as a lure, I spent the next fifteen minutes on bent knees trying to coax him to me. All to no avail. I snapped my fingers, whistled, and cursed him as I used to do, but he only crouched in the path and stared unknowingly at me. This was a strictly wild creature.

However, bits of hamburger tossed out gradually brought him nearer. At last, with great caution, he actually fed from my hand. There could no longer be any doubt. This was Rowdy! Yet I could not draw the slightest sign of recognition from him. Too soon his appetite was satisfied and he began to think of leaving. I decided on a last desperate chance. With great difficulty I lured him once again to my hand. Then, with my heart beating, I cuffed him playfully on the side of his head. Instantly I was greeted with a playful charge. At last I had touched the right key.

He lashed the air with his great brush of a tail. With bewildering agility he danced circles about me. Taking my hand in his teeth, he would mouth it with pretended ferocity.

We chased each other until I was completely exhausted. Then I threw apples to keep him entertained while I rested. The airy grace with which he capered over the landscape was as smooth as a breeze-tossed bubble. When a rain cape was casually tossed on the ground, Rowdy snatched it and raced 100 feet or more to hide it behind some bushes.

For all his play, however, he remained very noticeably a thing of the wild. Apprehensive and skittish, he would bolt for the brush at the slightest unexpected move or sound. He delighted in chewing my fingers but refused to allow me to stroke his head and preferred to keep just out of reach. When, for the sake of a picture, I grabbed his front paws and lifted him clear of the ground, he chewed my fingers with increasing vigor until I was forced to put him down.

Our playing continued for nearly an hour. Then with no hint of a warning, Rowdy was gone. He left as silently and mysteriously as he had come.

Rowdy has never identified himself since. Surely here was an animal of two worlds, and I am sure he is happy in the wilderness which belongs to his kind.

Norman D. Harris.

South Byfield, Mass.

LETTERS —*Continued from page 169*

Sirs:

. . . May I take this opportunity to congratulate you on your exceedingly interesting Natural History Magazine. I find your publication the best-presented paper of its kind and its contents the most interesting of any magazine that I read. . . .

F. W. Lange,
Museu Paranaense, Assistente.
Ponta Grossa, Brazil.

Sirs:

Since many soldiers and school teachers who are interested in natural history frequent our Library, which we are endeavoring to enlarge, we should appreciate receiving a free subscription to the magazine, Natural History, if possible.

Arthur R. Benson,
Director, United Service Organization Club.
Macon, Ga.

Natural History readers who wish to sponsor subscriptions for this

Continued on page 222

◀ "One day while I was teaching at Berkshire School, I stalked a fox and took as my prize 'Rowdy,' who chewed my fingers all the way back to my room"

▲ "This time it might be said that the fox had 'swallowed the canary.' Rowdy would stretch his legs out behind him and lie grinning devilishly from his round furry mass"

◀ "Rowdy felt perfectly at home while sharing my room. There was no article or corner that he did not consider his own. He felt equally justified in chewing my fingers and ripping my clothes"

➤ "It was always well to read my mail before putting it in my desk. For Rowdy was adept at opening drawers and would soon censor it to bits"

▼ "Looking at him one night as he quietly chewed his tail, I realized it was unfair to Rowdy to keep him from his natural environment. I decided to carry him back to his home on the mountainside at the close of school"

"By September, Rowdy was again a creature of the wild. But when I cuffed him playfully on the side of his head, he recognized me and we played one more hour together" ➤

—*Continued from page 220*

worthy agency are allowed a 20% reduction in the subscription price; $3.20 sent to the Circulation Department will pay for a year's subscription.—Ed.

* * *

Sirs:

. . . I think Natural History Magazine is the best magazine that I have ever read.

I would like to see more articles like "Southern Asia in the American Museum" (November-December, 1930), "A Pre-View of Eight Groups in the Akeley Hall of African Mammals" (January, 1936), and "A Grand Tour of North America" (April, 1942). I think that members of the Museum who live far away would enjoy articles like these, especially of the groups in the balcony of African Hall. . . .

John A. Rissling.

Philadelphia, Pa.

Future issues will contain a number of such subjects.—Ed.

* * *

Sirs:

The accompanying photograph shows the mating of a male and female walking stick (Phasmidae). The male is the small insect extending from the tree, and the female is stretched tightly against the tree, head down, with her two front legs in front of her head.

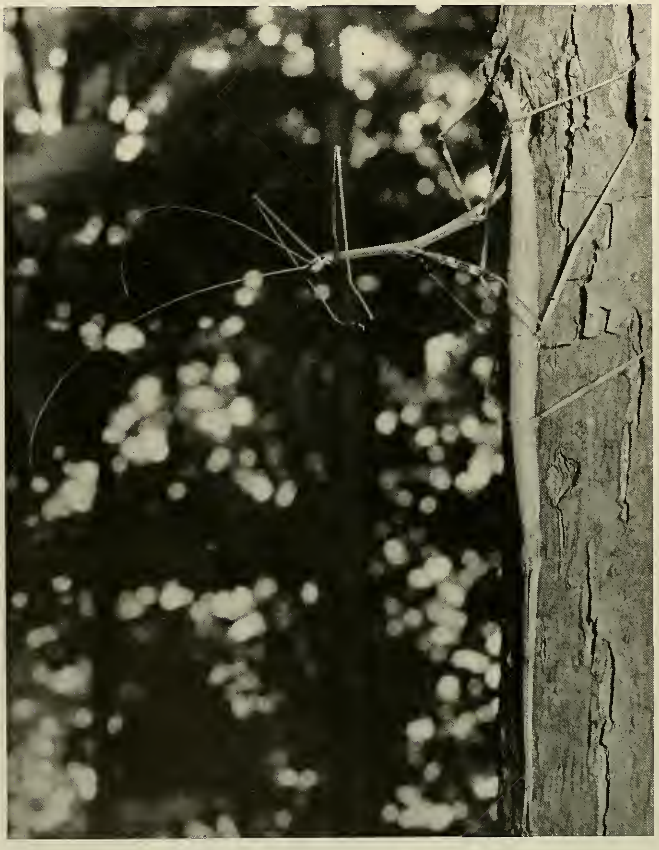
I first observed the mating on the side of a small basswood on my Duanesburg, N. Y., farm at 7 A. M., August 21. When I returned with a camera three hours later, the insects had not changed their positions.

Incidentally, I am still receiving occasional letters about snow rings. So far I have received almost 100 letters as a result of the pictures published in Natural History last winter.

Duane Featherstonhaugh.

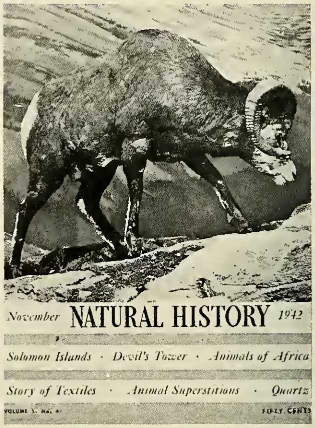
Duanesburg, N. Y.

Male and female walking sticks



NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on this page will be paid for at $1.00 each, with full credit to the photographer. Return postage must be included.

THE COVER THIS MONTH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The Bighorn Sheep is the only wild sheep native to the United States. The several varieties, some of which have been designated as distinct species, formerly were found from Mexico to Alberta and British Columbia, but the range is now greatly restricted. The animal represented on the cover in Kodachrome is *Ovis canadensis* Shaw. It keeps to the rugged mountains far above the tree line and only descends when forced down by deep snow. In the foreground is seen a Say ground squirrel, or "big chipmunk," as it is called in the West. The setting is Jasper National Park, which provides an appropriate background scene for the display of this animal in the recently opened Hall of North American Mammals in the American Museum. The group of which it is a part is a gift of Mr. and Mrs. H. P. Davison. This brilliant example of the taxidermist's art was mounted by Robert H. Rockwell under the direction of James L. Clark, and photographed in color by Thane Bierwert. The well-known artist Belmore Browne, assisted by George Browne, painted the background of the group.

URGENT

The Museum Library is in need of back issues of Natural History, particularly the first four issues for 1942. Copies sent to the Librarian, Natural History, New York, will be greatly appreciated.

Continued from page 217

sympathetic reception. Too many persons are allergic to the demands of conservation because they do not understand the issues at stake and they do not have the story presented in an attractive form.

The present book is a happy blending of the objective and subjective aspects of endangered American wild life. The reader finds the story told so entertainingly that his interest does not lag and yet the object lessons are there for all but the most heedless. What a rich fauna was disclosed to the early explorers of North America and what sad inroads have been made by the subsequent human occupation. How many significant actors in the wild life drama have taken their last bow. How many are today awaiting their call for a farewell to the American audience.

Fading Trails is the story of these events and selects the most important and most impressive examples. We are told what these mammals, birds, and other animals mean to us. We are informed as to the circumstances which threaten the existence of the species. We read of the measures taken for their protection or the things which should be done but have not because the public has not been aroused.

Conservation of wild life can be preached as a sermon. But, for those who do not care for sermons, let it be said that the reader of *Fading Trails* is not given dogma to be taken on faith alone. The account is logically presented and the arguments are forceful. There can be no question as to the desirability and the wisdom of conservation.

The attractive illustrations by Walter A. Weber, four of them in color, are excellent.

This authoritative, well-written book is highly commended to nature lovers and to those who have not as yet discovered nature.

HAROLD E. ANTHONY.

LIVES AROUND US

- - - - - - - - - - by Alan Devoe

Creative Age Press, $2.00

ANOTHER volume of nature sketches by Alan Devoe has just come from the press. In *Lives Around Us*, the author has given 20 essays or sketches portraying the life histories of creatures that almost any one could observe accurately but rarely does.

Mr. and Mrs. Devoe live on an old farm of more than 100 acres in the Hudson River valley. This land is kept as a wild life sanctuary. Here Mr. Devoe becomes intimately acquainted with the weasel, the fox, the woodchuck, the great horned owl, and the tiger of the air. His observations are accurate, and he tells about them in such a fascinating way that you want to read more about these animals or go out and make observations for yourself. His writings are free from sentimentality. He does not personify his creatures, but in writing about them he brings the fields and the woods to the reader.

Insects come in for their share in this volume. The author gives us intimate life histories of May flies, cicadas, mosquitoes, locusts, and grasshoppers. Especially good is "A Triumph of Instinct: The Dauber Wasp." It is complete and beautifully written. But so is the story of the snail, the turtle, the frog at the pond, and "Spiders: The Trappers of Outdoors."

The book is illustrated by 22 excellent full page woodcuts by Frank Utpatel.

As a naturalist, Mr. Devoe has explored the fields and woods since boyhood. One critic describes his books as "the finest writing of their kind since Thoreau." He has contributed to the *Readers Digest*, *The Atlantic Monthly*, and other worthy magazines. In a world torn with war and strife, this book comes as a refreshing interlude.

O. P. MEDSGER.

BIRDS OF NORTH CAROLINA

- - - - - - by North Carolina Department of Agriculture

State Museum, $3.50

FOR Americans interested in the birds of their own country, the "state list" forms the backbone of ornithological literature. Standard accounts of the birds of several states date far back into the last century. In our time, however, these have been succeeded by a new generation of books that have profited by the multiplicity of published articles and notes and by the findings of an ever-growing number of fieldworkers.

Among the southern commonwealths North Carolina occupies a distinctive place because it was the first to enact laws dealing with the conservation of wild animals and the seasonal production of game species. In the production of a state list of birds it was also a pioneer. As early as 1913 the first edition of the present work by Pearson and the Messrs. Brimley was in the final stages of printing, when the entire undertaking was destroyed by fire.

Fortunately a complete copy of the text was preserved in the form of printer's proofs, and the work was finally issued as the first bird book of the region.

In the present publication we have a complete revision of the earlier edition, with a large number of additional illustrations, including plates furnished without recompense by the artists Brasher, Horsfall, and Peterson. Equally gratuitous services by the three authors bas made possible the publication of the new edition at a low price, although the text has been increased from 380 to 416 pages and the forms of birds described have grown from 342 to 396.

The work opens with an historical sketch of ornithology in North Carolina. This is followed by a brief review of recent and contemporary research. In keeping with the special interests of the authors, the next section is devoted to bird protection. The subsequent systematic accounts of the species and subspecies include a description sufficient for identification and a statement on range and season. Tbe brief life histories have a refreshingly original stamp, showing that they are

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based chiefly upon firsthand observation, although they also summarize data from all published sources.

R. C. M.

THE SEASHORE PARADE

------ by Muriel Lewin Guberlet

The Jaques Cattell Press, $1.75

THIS natural history of the seashore is written in a popular style apparently aiming toward readers of ten or twelve years of age. Not a single scientific term is used, yet a wide variety of forms are dealt with in such manner that the various species may be recognized by one familiar with the region covered, though unfortunately the author does not tell us that this is limited to the Pacific Coast from Monterey Bay northward. The book, therefore, would scarcely serve as a guide to the sea-life of the Atlantic seaboard and would be utterly confusing to anyone attempting to use it in that way.

For instance, the common Pacific Coast scallop described would not be recognized in either our shore scallop (*Pecten gibbus*) or the commercial deep sea scallop (*Pecten magellanicus*). The same criticism would apply to the starfishes, worms, chitons, whelks, clams, barnacles, crabs, and others.

"Sharp spines" are not removed in preparing commercial sponges, as stated, for these sponges never had any, as in noncommercial sponges. Jellyfish tentacles have sting-cells throughout their length, not merely at the end. It is most inaccurate to say that "jellyfish manufacture electricity," since their luminescence is clearly the result of a chemical process.

The statement that the coral opens and closes a door at the top of its limestone house is incorrect. The coral calyx is open at the top and never possesses a "door." Nor do the tube-feet of starfishes "open and shut like medicine droppers." They terminate in closed pneumatic disks which are controlled by the pressure of the water vascular system distending them.

In a book which aims to deal with the facts of seashore life, it is unfortunate that the illustrations should be gaudy and unreal modernistic pictures, rather than those of a realistic style. While, as a whole, the book has some features of merit and shows a most sympathetic attitude toward children, it is a serious mistake that its special Pacific locale should not have been clearly defined to the youthful reader.

ROY WALDO MINER.

JOHN TORREY, A STORY OF NORTH AMERICAN BOTANY

- - by Andrew Denny Rodgers, III

Princeton University Press, $3.75

THE author first became interested in the history of botany in America through his grandfather, William Starling Sullivant, the pioneer authority on mosses. His biography of Sullivant, entitled *Noble Fellow*, was so well done that he was encouraged to set forth the lives of other great pioneers in botany. It is not surprising that the next subject he selected was John Torrey, who has been called "The Father of American Botany," and who was a contemporary of his grandfather, the great American bryologist.

This life of the great botanist and chemist, with special reference to the early history of botany in America, is made more attractive by a spray of the evergreen, *Torreya* on the jacket, a title-page photograph of the "gauntly beautiful" Torrey Pine, and a fine frontispiece portrait of John Torrey.

To Torrey came most of the botanical materials collected by all the great expeditions of his time—the military and geographical explorations and railroad surveys concerned with the winning of the West. After classifying this valuable material he distributed it to the embryonic herbaria of the country. He had most to do with organizing the herbarium of the Smithsonian Institution. Asa Gray, who was his closest friend, was once his pupil. Naturally the Harvard College herbarium profited greatly by the work of Torrey. Torrey's private collection went to Columbia College, and is now installed at the New York Botanical Garden. This is an excellent biography—a very human story —prepared with great care, of one of America's early scientists, who had so much to do with organizing our great scientific societies, journals, academies, museums, and herbaria. It is dedicated to the Torrey Botanical Club.

CLYDE FISHER.

Answers to Questions on page 219

1. Brazil.
2. An opossum.
3. Ammonia was named after the temple of Ammon-Ra, because the priests prepared a bleaching powder which worked because of the ammonia it contained.
4. The rhinoceros is larger, being second only to the elephant among living land animals.
5. A spinster.
6. False. Despite its apparent inaccessibility, the top of Devil's Tower is inhabited by chipmunks.
7. True. In spite of a common belief that elephants and other animals live to great ages, man under civilized conditions exceeds them all in average life span.
8. Twenty-three opossums weigh the same as a penny. The adult opossum weighs from 6,000 to 15,000 times as much as the young.
9. Penelope, the wife of Ulysses, who told other suiters they must wait until she finished the work on her loom.
10. The "tusks" of the rhino are neither bone nor horn, but are compacted hair.

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LETTERS

Sirs:

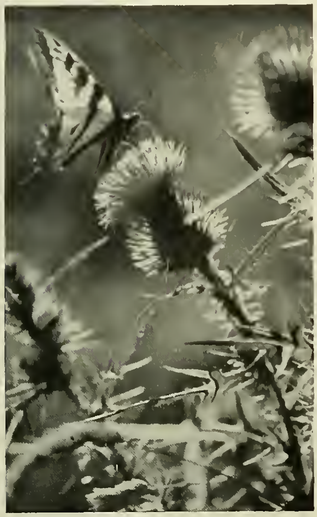
I cannot tell you how much I enjoyed George Miksch Sutton's article, "A Modern Audubon in Mexico," that appeared in the October issue of Natural History Magazine . . . John C. Muzzall.

Coopersville, Mich.

* * *

Sirs:

My family has subscribed to Natural History for many years, and we all really love it. I have been particularly interested in the photographs of wild birds and insects. Enclosed is a picture I snapped this summer near Eugene, Oregon, of a Western Tiger Swallow-tail (*Papilio rutulus*) feeding on a thistle. There were many of these beautiful lemon yellow and black butterflies in the hills.



Jocelyn Clise.

Seattle, Wash.

* * *

Sirs:

. . . We think that Natural History Magazine is the best and most interesting magazine we get.

The only criticism which I personally have to make about Natural History is that recently it has been getting to look more like ——— and ———, that is, with photographs taken in a way to be sensational . . . Henry Schmidt.

Philadelphia, Pa.

* * *

Sirs:

I know many others besides myself have agreed that Natural History is the finest magazine in its field.

As one who is greatly interested in photography, I can truthfully say that Natural History is also the best magazine on photography. I have seldom seen the equal of the photos, especially the covers in color. And the articles by Charles H. Coles are the best and most useful ones I have ever read. They should be printed in book form. Felix Oser.

Woodside, L. I., N. Y.

* * *

Sirs:

I thought I would write you and say how much I enjoy and look forward to your Saturday lectures for Members' Children. My father is a member of your Museum, and our family never misses your lectures. . . I remember your thrilling movies of Africa that I saw years ago. You do the whole business so well—I'm sure that if I were little I wouldn't be bored or restless. I did come when I was very little, and I was very excited to see the movies, then a great treat.

Perhaps you don't realize what a "service to humanity" you are doing, with your museum, the magazine, and the lectures. Your whole institution has been very important in our life, and I hope you will always be successful. Thank you for it. Shirley Worcester.

New York, N. Y.

* * *

Sirs:

"Coaxing earthworms up out of the soil" as discussed by Clifford B. Moore in the November Natural History is quite contrary to the common practice around Twin Falls, Idaho, where many people get night crawlers (very large angleworms) with an electric outfit. I use such an outfit on occasions when I have not had time to get them at night with a flashlight. . . .

These large worms I am told were imported here from the East. They are thick in many of the lawns of the town and in the garden and flower plots. If we have time, we give the lawn a good soaking before using the electric outfit, as we find the current is much stronger and the results quicker.

Some of the electric devices have two wires, but mine has one wire leading from the push-in socket in the house, outdoors to the two small steel rods which are stuck in the ground two to four feet apart. In a couple minutes the worms begin to appear, some headfirst and some tailfirst, struggling as though in pain. On a hot day when the surface of the lawn is dry, the worms will lie on top; but generally the grass is damp, and the worms begin to move away as soon as they are up. They crawl pretty lively, and when they get three or four feet from the steel rod they burrow into the earth again. I don't have much success just setting the outfit and going away for ten or fifteen minutes to work in another part of the yard, but must stay on the job. When one is about half out, I grab it quickly and jerk it out easily. If grasped slowly, the worm swells and sticks in the burrow. . . .

I have gotten as many as 23 big worms from one set; and my son told me he got 40 from one set. A neighbor boy has made part of his spending money selling night crawlers for some years and has

Continued on page 276

Natural History

ILLUSTRATIONS

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Above illustration—Nile River Group—Detail showing Antelope Akeley African Hall—American Museum of Natural History

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

FREDERICK TRUBEE DAVISON, President
ALBERT E. PARR, Director

VOLUME L—No. 5 ★ ★ ★ ★ ★ ★ **DECEMBER, 1942**

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From a Kodachrome of Lychnosphaera regina *by Charles H. Coles*

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You will find NATURAL HISTORY Magazine indexed in *Reader's Guide to Periodical Literature* in your library

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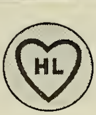
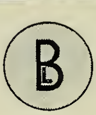


▲Strength and wisdom personified. The elephant seems able to do everything except read the company's brand on a log *(lower right)*. A heart with "H. L." was used after Harry Lingard, the author's host on the trip, had O.K.'d a log



TRAINED TUSKERS
of the Teak Forests

By Truman Bailey*

All photos by the author

Into the jungles of Siam to observe the elephants whose fame is a byword for intelligent cooperation between animal and master

Harry Lingard, who knew more about elephants than any other white man in Siam, died of jungle fever not long after we made the expedition into the teak forests I am going to tell you about.

At first Lingard objected to taking a stranger with him into the jungle to observe how the elephants work and are trained. He had gone out there after the war and had spent most of his time on the Burma-Siam border. He spoke fluent Siamese and Laos (pronounced as if the 'd' were left off 'loud'), and was respected by the natives as a stern but kindly supervisor. Once he gave consent to my accompanying him, however, he proved a helpful host and a delightful companion.

Concern was shown on every hand regarding my ability to stand a jungle trip, particularly with Lingard, who was noted for his drive. He dryly promised me an exciting trip. However, I could not see that it should be more difficult than any of the hundreds of trips I had taken into the mountains of Oregon packing my own kit. So I bought a pocket notebook in the market place at Lampang, with a portrait of King Prahjadhipok on the front cover, and packed my camera and other meager necessities for the trip. It is from the pages of that diary that I give you this account, almost verbatim.

On the morning of our departure I awoke to a din of barking dogs, howling babies, and crowing roosters. From my window I could see Cole, the thick-necked Chinese pony that looked like a T'ang sculpture, being warmed up by the stable boy. Cole was to be my mount; Lingard would ride Revelation. Between the two there was little choice. Cole was a devil with a tough mouth and an insatiable desire to go first, Revelation shied at every chip of paper or native.

For 25 miles over the roughest sort of trail we did a mad "Paul Revere." Seemingly there was no wear-out to our tough little mounts. Our trail wound through a thick jungle growth in which every branch was heavily encrusted with hungry thorns, which raked our backs and ripped long tears in our shirts. Frequently our sun helmets would be snatched from our heads by a particularly vicious tree. A Russell's viper slithered through a shallow pool and into the thick brush, giving Revelation something to shy at. Sometimes we dragged our ponies, slipping and lunging down creek beds filled with tepid water. Snakes and leeches filled my mind as we waded waist-deep.

The maze became more impenetrable, and finally, Lingard, exasperated at his failure to recognize a familiar landmark, inquired of a native squatting in front of a jungle hut guarding a rice paddy from marauders. Information was denied, until for a few pennies the austere gentleman was employed as our guide. We then started across the rice fields at a killing pace. The ponies kept slipping down into the muck and had to be led. After several hours of apparently aimless scurrying, we came out on a clearly defined bullock track which Lingard recognized.

On a swimming horse

Our troubles were not over yet, as there were three rivers to cross. As they were in the rise, I was filled with concern for my precious photographic equipment. In the first one we waded for 300 yards, getting wet to the stirrups only, and struggled up the steep bank. The jungle closed in again. The next river was more threatening. Cupped between narrow banks, the water swirled and eddied, and it was obvious we would have to swim. I prepared to dismount, as it seemed impossible that the tiny ponies, thirteen hands high, could swim with us; but Lingard said to stick on unless Cole started to flounder. I tucked my precious camera inside my shirt and prayed to the luck goddess that it wouldn't be lost. It was amusing to note the serious businesslike attitude of both ponies. After about 75 feet of shallow water, we slipped with a sudden lunge into the main channel, and the horses were swimming. The sturdy little mounts never faltered. Soon we were clambering up the slippery bank. Here Cole slipped and whacked his nose. I dismounted willingly and helped him up the bank, feeling grateful indeed for the good work he had done.

The final river was not difficult, and after a brisk canter we pulled up at the Wat (native church), hungry as blazes.

It is an accepted custom for whites traveling through the jungle to avail themselves of the native churches for shelter. So long as the visitor complies with the regulations imposed by the

---

*Truman Bailey is known to readers for his contributions to NATURAL HISTORY on Samoa and the ancient ruins of Angkor. By foot and on bicycle or animal back he has explored many parts of China, Japan, and other oriental countries, as well as numerous islands of the Pacific. Much of his attention as an artist has been devoted to the preservation of native artistic traditions in a machine-dominated age. His pioneer work in "discovering" and developing obscure crafts has reinforced the cultural individuality of many people and brought them greater economic freedom, at the same time that their creative talents have enriched the world. In the anthropological sense, his work is a phase of conservation—a sorely neglected one. As this goes to press, he is flying to South America under the auspices of the Inter-American Development Commission to conduct a protracted survey of native arts and their possible bearing on the lives of North Americans.—Ed.

➤ A JOURNEY into the teak forests along the Burma-Thailand border is a strenuous undertaking and is not frequently made by men not in the business. The trip by the author to photograph the work of these trained elephants was made on horseback, with elephants transporting the baggage. Transport work of this type is generally done by teakers too old for heavier duty and by trained calves serving their apprenticeship. So difficult is the task of removing the timber that five to ten years are required from the time a tree is felled until it is drifted downstream to Bangkok

▼ HUGE BASKETS distribute the load evenly. Lack of refrigeration in the primitive camps necessitates transporting fresh meat "on the hoof," and live chickens and pigs are conveniently conveyed in these baskets. If an elephant is overloaded, a shrill trumpeting of protest gives instant warning

bonzes, or priests, he is welcome. He must sleep with his head towards Buddha and must not perform his toilet in the compound. No animals are allowed, and no women can sleep in the temple—a very strict rule. From the ceiling of the Wat, not far from three Buddhas, hung two crudely made airplanes—prophetic of the world to come in this remote land.

We dined well and on spotless linen: fish patty, chicken, a delicious souffle with figs, coffee, and chocolates out of a tin.

From the Wat our trail was too rough and slippery for riding and for the most part followed the creeks, waist-high with flood waters. Occasionally we halted to inspect teak. This involved checking for defects, sawing off faulty or hollow ends, ascertaining depth of pits or holes by running a stiff wire into them or a bamboo split if deep, and finally branding them over the length of the log to indicate the Borneo Company. Sometimes a particularly good log received the brand of approval on both ends, and of course there would be trouble if this log arrived minus one brand.

It is five years from the time a log is cut until it arrives at Bangkok, sometimes ten. Two years of this is required to dry the logs so that the heavy wood will float. A season is allowed for the elephants to get the logs to water, and another season awaiting a rise. Then it will take another season to get the wood to Bangkok, possibly much longer.

The day we traveled to our camp we covered 25 miles on horses and 20 miles on foot. But we were rewarded by, of all things, a "shower bath." We stood on a "bath mat" of velvety banana palm leaves, in a square enclosed by black cloth (black so it would not attract mosquitoes), and buckets of water were fetched by our personal servant. Then the business of soaping and sluicing began. What luxury, I thought, as the boy stood at attention awaiting the signal for the final bucket. In the distance thunder started its evening roar, and the first heavy drops of rain fell on my bare skin.

Tired but relaxed, I reclined to puff on my pipe and write my notes while Harry Lingard interviewed his jungle workers, sheltering themselves from the gathering storm under large parchment umbrellas. My diary reads: "In native dialect notes are compared, salaries paid, events discussed. All this is the business of taking teak out of the jungle. Large drops fall on the thatched grass of our shelter with a soothing splatter. Through the gloom

of early evening the light from the cook shack gives evidence that dinner is on the way. A 'Coleman' gas lantern, reminiscent of home in Oregon, hangs behind me. . . . In the distance I can hear the musical note of the wooden elephant bells. The mingled odor of our supper and the smoky tang of the always damp jungle firewood, drifts to my nostrils.

"A coolie just came in who was on hand when a wild tusker, intent on conquest with one of the worker females, killed a fellow coolie. The account runs that a group of workmen tried to kill the tusker for the damage he was doing to the camp and neighboring rice paddies. They were blazing away with ancient Winchesters when the bull turned and charged. This one poor fellow stumbled and fell, and the maddened elephant, kneeling upon him, rammed him through with his tusks.

"The coolie who is telling the story is typical of Siamese workmen. He receives a food allowance of 4.00 ticals ($2.00) each month. Other than this he does not draw his salary for eighteen months. One day soon he will collect, have one grand drunken, gambling, opium-smoking orgy and with a very sad head will return to work for another eighteen months.

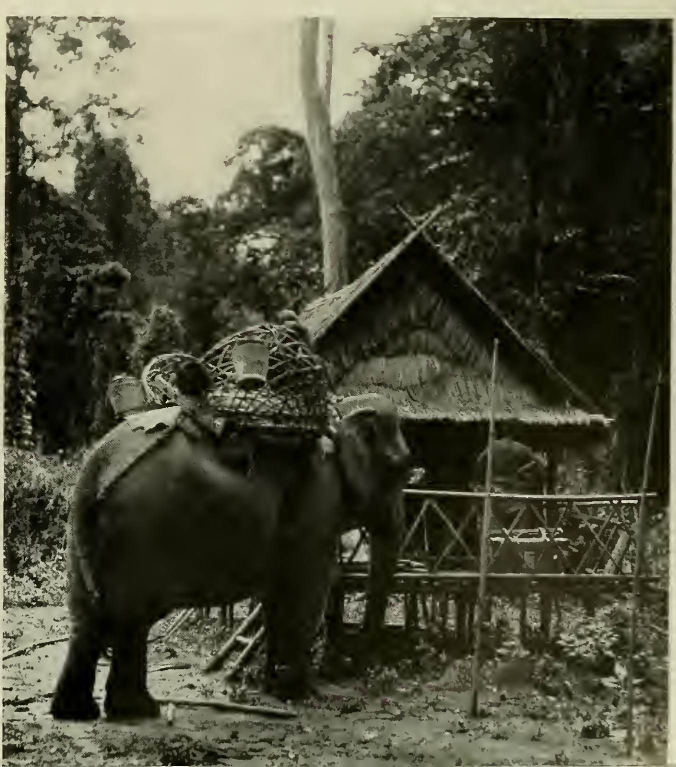
"Today . . . I saw a most amazing sight—elephants working a sidehill so steep it was incredible how the huge beasts could save themselves from slipping into the gorge. They were pushing great logs down the hillside, which crashed to a resting place at the bottom of a ravine whence they will be snatched by the flood waters when the stream rises to full height.

"There are many questions to ask about elephants, and it is fascinating to get Lingard talking on his favorite subject. His knowledge is profound, embracing many years of intimate firsthand experience. He is extremely tolerant of some of my sillier questions. One of these, the fable of the common dying ground of elephants, he answered positively. Elephants die like any other animal. Many of them, in pain, rush out into the jungle to be seen no more. Most of them die as unromantically as horses. He has been on hand for many such departures.

"He knows every one of the hundreds of elephants we have seen—its idiosyncrasies, age, and condition—and at a glance can tell whether it is being well treated or poorly. The elephants know him, too, and respond to his caresses. Ordinarily elephants hate the smell of whites and will show their distaste in violent ways. I was no exception and found it safer to keep my distance.

"An elephant carries its young 20 to 24 months. It is said that bull calves require the longer period. They nurse for three years. It is not unusual to see two mothers nursing the same calf when one of them has lost her baby."

▼ A JUNGLE CAMP is thrown up quickly from the bamboo and thatch near at hand. After a short period of use the hut must be destroyed, as it becomes infested with scorpions, centipedes, and other undesirable occupants. The stilts that raise it off the ground are a protection against moisture and snakes. This hut is the Borneo Company's Lampang Camp No. 3

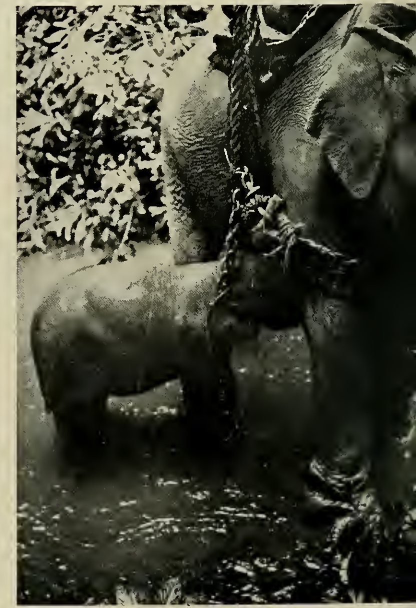


◂ All luggage must be covered with tarpaulins, as the sun rarely shines for more than a few minutes. Even in the dry seasons there is an almost continual drizzle of rain, which swells to a heavy, unremitting downpour during the wet months. Elephants are capable of two or three miles an hour, or 25 miles a day. They tire easily at a faster pace and rebel at greater distances if heavily loaded

▸ A thousand pounds of green fodder and 25 pounds of unhusked rice are consumed daily by a full-grown elephant. However, the animal is content with many varieties of herbage and picks up most of its food along the trail while working, so that low upkeep is a strong point in favor of the elephant. A great fondness for rice leads elephants into mischievous raids on native rice paddies. The outraged farmers, frequently seeking reimbursement far beyond the damage, are required to file their complaints in the home office at Lampang

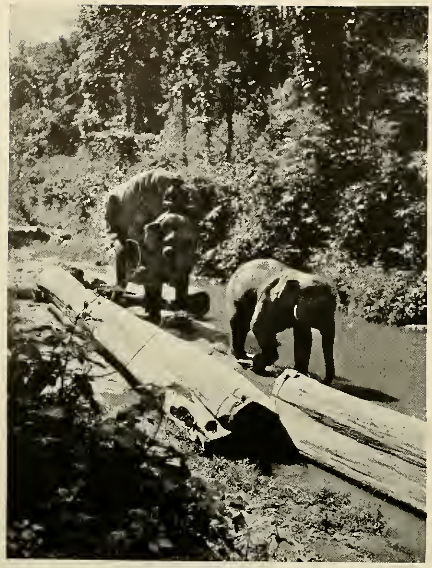
◂ The two-year-old pet of the teak camp at left was as playful as a puppy. Sauntering along with the working elephants, he would fill his trunk with water from the stream and squirt it at whatever object he considered a fair target. With unerring accuracy he would drench rocks, older elephants, and even the inquisitive photographer

▸ Cow elephants generally produce one calf at birth, but twins have been known. In nursing, the calf curls its trunk back over its head to reach the mother's breasts with its mouth. The young elephant procures its food in this way for two years, not only from its own mother but sometimes from another elephant who has lost her own offspring. Training for the teak forests begins soon after three years



◂ A seven-year-old calf, which will require another six to nine years of training before it becomes a full-fledged teaker. Meanwhile it will do chores around camp and may be harnessed to light tasks such as hauling rice. The elephants enjoy their work and are pampered by their masters. Among the Karen tribe, famous for their training of elephants, a child will ride a young elephant as an American child would ride a Newfoundland dog. The calves require affection, understanding, and patience, for a harsh word may destroy an elephant's usefulness

▼ SURE-FOOTED AND REMARKABLY INTELLIGENT, this colossus of power performs tasks for man in the almost impenetrable forest, where mechanical tractors would be of little use. Streambeds are used extensively for hauling. The footing is rocky and slippery, and a torrential downpour may bring an instant rise of several feet in the water. Properly harnessed, a mature elephant can drag four tons over rough ground



◄ Gold of the jungle: teak logs lying along a streambed in the forests of the Burma-Thailand border. The logs are branded on both ends—a respected mark of ownership corresponding to the branding of cattle in our western states. There will of course be trouble if the brand is missing on one end

➤ Slow but sure, the elephant needs only a narrow track down the steep clay bank of a river. With remarkable sagacity, the animal maneuvers the logs to the river's edge, where flood waters will in time sweep them down stream. The logs have been seasoned for two years to make them light enough to float

I learned that an elephant starts training soon after reaching three years of age. At thirteen it is completing its apprentice stage; at nineteen it becomes useful. At 35, perhaps 40, an elephant achieves its prime. At 50 years, on the average, its period of usefulness is ended.

In this locality the Karens, a northern tribe, buy calves at the American equivalent of about $250.00 each and will exchange three calves for a trained elephant.

The elephants require affection, understanding, care, and patience, and the Karens love them, pamper them, and treat the babies like pet puppies. The children ride them as American children would ride a Newfoundland dog.

An elephant is best trained by one mahout, with the assistance of many attendants. Frequently a mahout will make it his lifetime task to be the keeper of that particular elephant. The head of a wild calf is fitted into the narrow end of a V-shaped wooden stock. A strap is fastened under the belly, lifting a portion of the weight off the feet, and another fits across the back. The elephant is starved for 24 hours and receives its first food from the hand of the trainer. It is caressed and petted each time it is fed, until a bond of affection is established between master and beast.

When the calf is thoroughly aware that the man is its friend, the mahout makes a gentle approach toward sitting on its head. As soon as this is successful the straps are removed one at a time. It may take weeks. Next step is to take the calf for a walk between several coolies armed with long spears. It must not be forgotten that a four-year-old elephant on the rampage can be a deadly adversary. Besides, the elephant is an investment which can be lost through one curt word.

The slow process of teaching the commands is now undertaken and requires six months to a year or more. The commands in Siamese are as follows:

MEP—to kneel
YA—to stop when working
MAH LOOM—to lift or turn over
SIGH—to lift a leg for hobble
TOH—to push end downhill
PEH-AR—to push over easy
SUNG—to let mahout get up by lifting leg
MAH YAK—to lift
SUK—come back
NIM—steady
HOW—in conjunction with another word, meaning steady or stop
QUAN CHANG—is the term to indicate elephant rider or mahout
CHANG—is elephant

The remarkable intelligence of the elephant and its love of work reduce the need for urging, and the mahouts use vocal commands to a minor extent only. The name of a cow elephant always has the prefix *Me* or *Meh,* while the males have the prefix *Poo.* A bull with one tusk would be called *Poo Ek;* one who had lost his tusks would be *Poo Sedaw. Meh Koot* would be a female with a short tail, and so on.

Both male and female elephants have tusks, but those of the bull are longer and heavier. Tusks are frequently broken while working, and sometimes they develop infected cavities and must be extracted. When badly splintered they are sawed off; but one tusk is better than none, and the elephant makes frequent use of this unusual tool.

The bulls have a tiny hole over the eye, which periodically becomes swollen, at which time a "must" or "oil falling" takes place. A healthy male

➤ Spoken commands are rarely given, though the elephant understands a number of them as described in the text. Pressure of the foot behind the ear and shifting of the weight of the mahout, or trainer, guide the animal in the performance of its tasks. The elephant is affectionate towards his master and responds to kind treatment. The natives, in turn, are devoted to the huge creatures. A mahout may give his whole life to the care and teaching of a single animal. In many villages white marble shrines honor the elephant god Ganesha, worshipped by the jungle people

has this about once or perhaps twice a year; but if the animal is overworked, three or four years may intervene. During this period an otherwise gentle beast may go stark, raving mad and usually has to be heavily chained near a supply of water till the condition wears off. If the bull breaks loose, he may kill anything in his way.

Lingard recounted an incident which he himself witnessed. An otherwise gentle tusker weighing well over three tons broke loose and went on a rampage. Captivated by an old cow, he made ardent advances but was repulsed. Without further ado he impaled her on his tusks, ramming both of them through her, broadside. Having committed his crime of passion, he tore through the jungle clearing a wide path, with the cow still on his tusks. Finally he smacked full speed into a stout teak tree, burying his tusks so deep that they had to be cut out with an axe! Later, other eyewitnesses verified this almost unbelievable account.

Traveling farther through the dripping jungle, amid ferns that rose higher than our heads and bamboo thickets that grew densely beneath the festoons of thorny creepers hanging from the trees, we ultimately came upon a clearing where another group of elephants were working teak down the stream bed. Occasionally the still air would be split with the roar of a petulant beast whose log had become "hung" on an obstruction. Here I had opportunity to witness an amazing demonstration.

An independent trouble-shooter

It was the responsibility of one ancient tusker to straighten out jams wherever they occurred. A scream from an elephant whose log was jammed between two rocks would bring the old fellow trundling up to the scene, like a wise and patient superintendent. He would take in the situation and then, with a fine application of practical physics, would push here or tug there—and the log was free. Trumpeting triumphantly and as though very pleased with himself, he would move along to the next task. Rarely would the mahout give a command.

A small fat calf was particularly amusing. The little fellow was constantly searching for food with his hungry little mouth. Or, while sauntering idly along, he took special pleasure in filling his trunk and squirting at whatever object took his fancy as a target. With deadly aim he would squirt rocks, his mother, and the squealing mahouts. When the impudent trunk was aimed at me, I retired in haste—to the delight of the mahouts, who howled with glee. Out of range, I kicked myself for not chancing the wetting to get a picture of the little fiend.

We met rough going down the bed of a creek, and gravel filled my tennis shoes until my lacerated feet started bleeding. And as we scrambled through the bamboo thickets, I inspected every stalk before grasping it, because one of the deadliest snakes is identical in color.

Jungle Camp #2 was set in a beautiful forest, with wild foliage pressing in on all sides like a solid wall. Rarely does a breath of air stir on the jungle floor. The sensation of being stifled is made stronger by the muted sounds that are silenced without echo by the absorbent mass of greenery. Wild flowers were everywhere. When the steady downpour of rain gives way to infrequent sunshine, the rising steam from the warm earth brings with it the perfume of green verdure and the exotic scent of tropical flowers.

Here at Camp #2 we treated ourselves to the luxury of a hot bath but pushed on immediately after tiffin. Soon we were ahead of the elephant transport, which averages about two and one-half miles an hour. Making a short cut through some rice paddies, I noticed that the bullocks which were plowing had appendages from five to eight inches long and two inches in diameter hanging from their stomachs and chests. I asked what they were and was told they were leeches. Did they ever attack human beings? Oh, yes! One got them while wading in the streams where they breed in the tepid water. The bullock is a gentle pet to the natives. But to a white it can be one of the most ferocious animals. It is fast, tricky, and armed with wide sharp horns. I saw a man on the operating table in Chiengmai who had been gored by one in a thorough and workmanlike fashion.

Back at the Wat, we felt almost at home. A clear starlit sky and cool breeze created a delightful atmosphere. A nose flute sounded its soft, petulant note far away, as some amorous squire courted a Siamese maiden. Through the evening could be heard the booming of drums calling the priests to worship. Their sound rippled like a wave through the jungle. At first, far away, one could hear a faint sound like an echo. Other Wats picked up the call, moving closer until—*Boom!* the eighteen-foot drum in our Wat would let go, causing me to fairly jump out of my skin. I think this was partly horseplay: the youthful bonzes were outdoing themselves to impress us.

The bad boy of the herd

When we departed the next morning we had a bout with an exasperating little tusker, who didn't seem to want us to mount our ponies. With a bellow he charged playfully. But a ton of elephant charging is not funny. Shouting and waving our sun helmets, we managed to drive him off. We walked fully 200 yards before attempting to mount again, and glanced back just in time to see him coming again in a mad rush, as fast as a horse on a dead gallop, with ears out and trunk up. Again Lingard stopped him with my futile assistance.

This time we hiked a long distance before attempting to mount. The same youngster had been quite a pest around camp, butting the ponies and raising Cain in general. While we were eating, his inquisitive trunk would come wavering over our dinner table, and he would single out something to reach for. Lingard would then administer a sound whack on the trunk with his fork, and the petted creature would assume as hurt a look as a young elephant can.

We arrived back in Lampang cut by thorns and covered with mud, but with a record of the elephants at work. Photographically I had met with incalculable difficulties. I did not know there could be so much water. The first night out my exposure meter and wrist watch rusted tight. When I reached into my "water-tight" case for filters, they fell apart in my hands. The film became so swollen with moisture that I could hardly slide it through the pack. Some of the pictures are blurred because of the wide open lens and slow speeds which I was forced to use in the darkness of the forest. But it is an honest record. It gives a true impression of the estimable teak elephant going about his daily tasks—tasks that make the ballyhooed tricks of a circus elephant look like calf's play.

▲ THE MAHOUT hangs onto a chain encircling the elephant's neck

▲ . . . AND KEEPS HIS PERCH like an acrobat

▼ THE ELEPHANT maneuvers in a narrow space and flexes his powerful muscles to separate the jammed logs

▼ . . . AND FINALLY sends the last piece of heavy teak wood splashing into the water

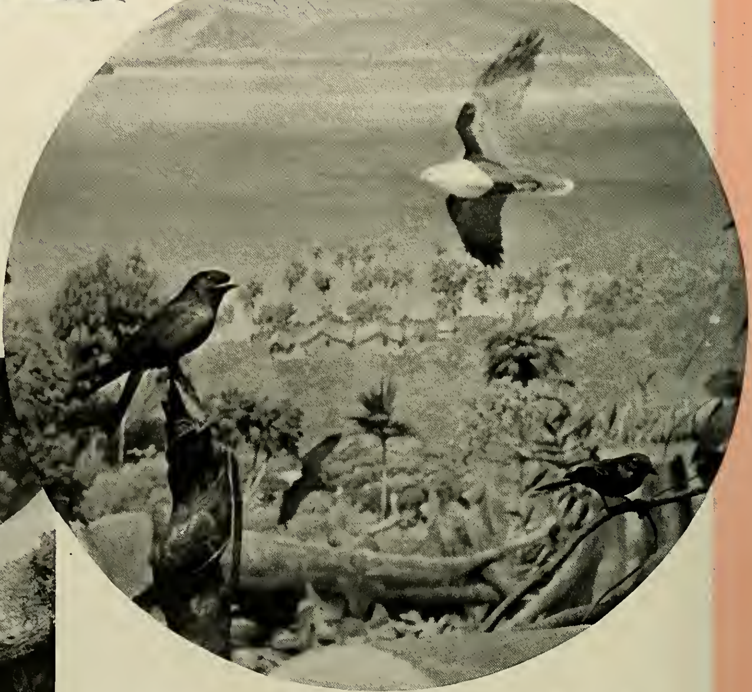
BIRDS OF

Science and art combine to portray the bird life of a native garden in a region prominent in the war dispatches from the Solomons.—One of four new bird exhibits recently opened to the public at the American Museum of Natural History

AMNH Photos by Coles

▲ A GIANT SWIFT soars into the jungle clearing which depicts the bird life of the Solomon Islands. The view, which is from Crawford Island, encompasses a native settlement (as shown at right) lying at the foot of a characteristically steep slope. Beyond it, across Marau Sound, lies the Island of Guadalcanal

▼ SCARLET PARROTS, displayed as in life on a vine native to the Solomons

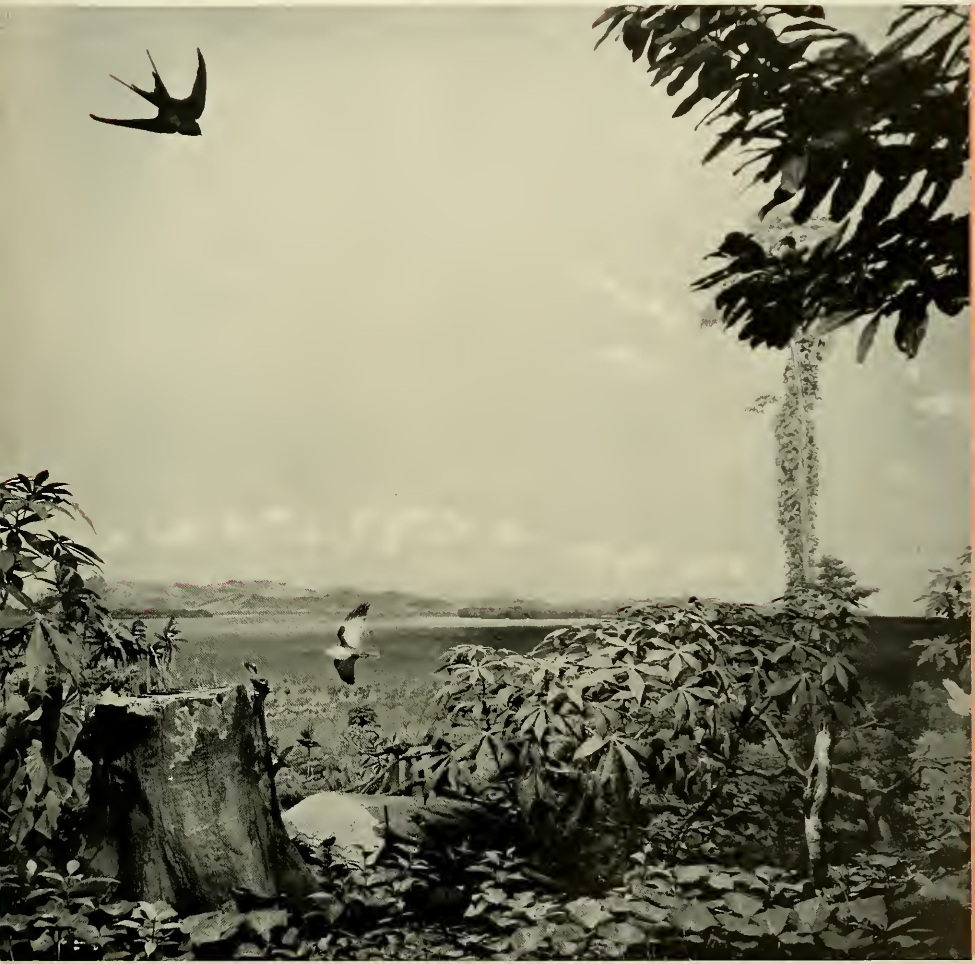


▲ THE LEFT-HAND BIRD is a roller *(Eurystomus orientalis)*. The one perching at right is the cuckoo-shrike *(Edolisoma tenuirostre)*. In the background, a Brahminy Kite is on the wing. The Solomons have remained little affected by civilization, and even today the Melanesians inhabiting some of the islands live in a substantially primitive state. The climate is exceedingly humid, the dry season being shorter than in the islands lying farther from the equator. The exhibit portrays the vegetation as it appears in the month of December.

The group was created by Dr. James L. Clark and his assistants, under the scientific direction of Dr. Robert Cushman Murphy. George E. Petersen, who accompanied the Fahnestocks, made the field studies and prepared the foreground. George Adams was associated with Raymond B. Potter in mounting the birds. Francis Lee Jaques painted the background

GUADALCANAL

THE MATERIAL for four new exhibits in the Whitney Memorial Hall of Birds was collected in large part by Captain John Sheridan Fahnestock and his brother, the late Lieutenant Adam Bruce Fahnestock, who recently lost his life in the service of his country in New Guinea. Prior to the outbreak of war the young explorers cruised the Pacific in the "Director II" but lost their vessel at the Great Barrier Reef in Australia in 1940. Fortunately they had already shipped their scientific collections safely to the United States. Construction of these new groups was made possible by gifts of Lieutenant Colonel Cornelius Vanderbilt Whitney. The Hall is a memorial to his father, Harry Payne Whitney, and his grandfather, William C. Whitney. It is located on the second floor of the Whitney Wing of the American Museum, which houses the world's largest study collection of birds



▲ THE BUSH FOWL *(center foreground)* lays its eggs in a bed of hot sand or scrapes together a pile of leaves that ferment and produce enough heat to incubate them. When the chicks hatch, they are at once able to fly and fend for themselves. Thus, they never know their own parents. The world's smallest genus of parrots is represented on the upright branch at lower right. This parrot, smaller than a sparrow, climbs trees and lives like a woodpecker. No fewer than 128 different birds are found in the Solomons. The archipelago is particularly interesting for the clear-cut way it demonstrates principles in the distribution and evolution of species

KNOW YOUR *Christmas* TREES

By Harry L. Spooner

Its life is a short but a merry one, for like some of the big night moths, the Christmas tree lasts a scant seven days. But in spite of its short life, there is nothing else in the Christmas festivities that contributes such a powerful influence as the Christmas tree. No matter how elaborate the other features of the Christmas merrymaking are, they all revolve about the Christmas tree as the central feature.

During the Yuletide every street and every avenue is transformed into a fairy isle by colored lights decorating the traditional evergreen. The pageant is repeated inside mansion and hovel with equal spirit, as the sparkling trees blaze forth the message of the season. The decorated Christmas tree has become a symbol in many parts of the world and is an important part of the Christmas celebration in almost every American home. Fifty years ago our trees were trimmed with red apples

HOW TO CHOOSE A

TRUE FIR

The Balsam Fir has a beautiful pyramidal shape, fairly rigid branches, and lustrous dark-green needles that do not fall as quickly as others

DOUGLAS FIR

The Douglas Fir is a fine tree of pyramidal form, with nicely spaced branches. It is easily the most popular Christmas tree on the West Coast

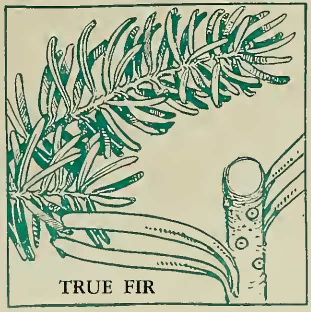
SPRUCE

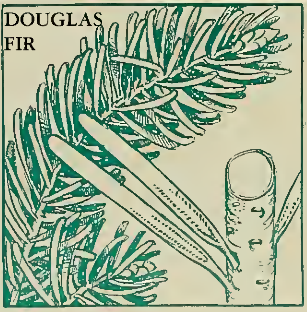
Spruces make admirable Christmas trees. The crown is dense and pyramidal. They provide about 25% of all the Christmas trees used in America

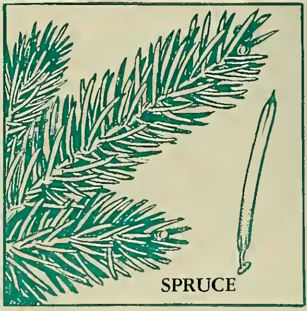
The central spike on these three is erect and strong enough to hold an ornament

HOW TO TELL THEM

If the needles grow singly on the branch, the tree is one of these four







If the needles feel SOFT when you grab them, it is a true fir or a Douglas fir

If the needles feel PRICKLY when you grab a handful, it is a spruce

If you pluck a needle and it leaves a CONSPICUOUS ROUND SCAR, the tree is a true fir. About half of all our Christmas trees are balsam firs

If you pluck a needle and it leaves an INCONSPICUOUS OVAL SCAR, it is a Douglas fir. The buds on the ends of the branches are sharp-pointed

The needles are usually four-sided and grow from a small woody base protruding from the branch. They are stiff and usually have a pointed tip and popcorn. Today a vast industry supplies factory-made ornaments.

As you read this, about twelve million trees, neatly bundled according to size and variety, are moving toward the hearths of America, and in the rush to get a good tree, the American housewife may well want to know more about them.

Practically all coniferous evergreens can be used for Christmas trees, but some are better than others. Most popular are the firs and spruces. Next in order are the pines and cedars. Accessibility is frequently the deciding factor. For instance, in Colorado, where fir is abundant but grows at high altitudes, making it difficult to get out, the lodgepole pine and the Douglas fir, growing at lower elevations, are more frequently used.

The balsam fir comprises probably half of all Christmas trees used. There are several reasons for this. The tree has a beautiful pyramidal shape and its fairly rigid branches are well adapted to supporting lights and decorations. Its lustrous, dark-green needles do not fall as quickly as those of other species. It has a spicy odor not found in other evergreens. And finally, it bundles tightly for shipment. This is a very important consideration, as the reduced bulk lowers shipping costs. On taking off the strings, the trees spring back into normal shape almost at once. The bulk of the balsam firs come from the northeastern and Lake states and Canada.

In the South the Fraser fir is used to some extent. Since it grows only on the high mountain tops of North Carolina and Tennessee, however, it is so difficult to get out that its use is limited. Likewise the Rocky Mountain states have plenty of fir but it grows so high as not to be readily accessible. It therefore gives way to lodgepole pine, Douglas fir and to some extent to Englemann spruce. On the Pacific coast the Douglas fir is principally used.

Spruces—black, red, and white—make up about one-fourth of the Christmas trees used. Black and red spruces are used commonly in the New England states, south to the region of Philadelphia. In Illinois and Ohio the demand for Christmas trees is partially met by nursery-grown Norway spruces.

Where firs and spruces are not readily available or are too high in price, the pines are used. Throughout Maryland, Virginia, and in Washington, D. C., the scrub pine is almost the only local species available for Christmas trees.

Such species as northern white pine, southern pine, hemlock, red and white cedar, and redwood are used locally to some extent. The flexible, drooping

CHRISTMAS TREE

HEMLOCK

Hemlocks have flat needles of a dark green color that give a beautiful lacy effect. But their flexible branches make them better for wreaths

PINE

Pines make suitable Christmas trees where better adapted evergreens are not available. Their artistic charm is in their very long needles

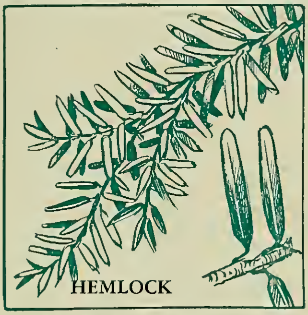
CEDAR

Cedars used locally as Christmas trees depart somewhat from the traditional form but hold their foliage much longer than some other evergreens

The central spike on these three is apt to be droopy or inconspicuous

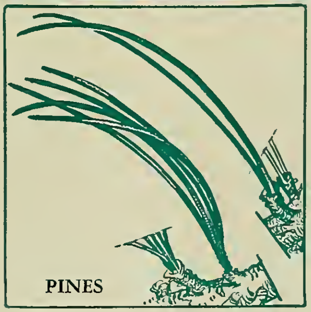
BY THEIR NEEDLES

Drawings by Laurence Blair



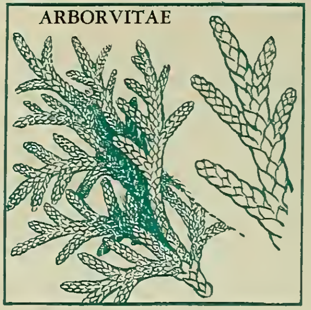
If the needles are short, fairly soft, and twisted at the base, the tree is a hemlock. The needles are generally blunt and are thrown into a two-ranked arrangement by the twisting of the leaf-stalks. The branchlets are usually slender and drooping

If the needles grow in bunches of two to five, it is a pine



Many different pines grow in North America, and the needles of all but one (in the arid Southwest) grow in bundles. Pines are used where firs and spruces are not handy. Lodgepole pine, for instance, is used under such circumstances in the Rockies

If the needles are scalelike, it is probably one of the "cedars"



Once recognized, the scalelike foliage of the arborvitae is not apt to be mistaken. Arborvitae and other "cedars" are used locally, as for example the incense cedar in California and the northern white cedar *(Chamaecyparis thyoides)* in the East branches of hemlock do not make it desirable for Christmas trees when other species are available. However, large quantities of its branches are used in making wreaths.

Some white cedars and arborvitae are used both locally and to some extent commercially in New York and Philadelphia. This tree has a delightful fragrance, and its flat leaves remain on the tree for a longer time than the needle-leaves of other trees. Nor is red cedar despised in some states where other evergreens do not grow. It is often used, in fact, in Tennessee and Pennsylvania although other trees can be secured. In California it is not rare to find incense cedar and redwood used as Christmas trees.

In the eastern states the trees are as a general rule owned by farmers, who sell them to cutters on the stump. In Wisconsin, Michigan, Minnesota, and Canada they are usually cut from lands owned by lumber companies—sometimes without their consent or knowledge. During the past few years, a considerable number of trees have been cut from national and state forests as part of their thinning operations. Of approximately two million trees cut in Minnesota, between 400,000 and 600,000 come from the state forests.

The center of the Christmas tree trade is in the big cities of the East. New York City and the New England states consume several million trees annually, a considerable portion of the total output. Christmas trees are cut and sold according to size.

The cutting of Christmas trees for shipping begins as early as August. Table trees are often cut during this month and placed in cold storage warehouses until the shipping season comes. The cutting of larger trees starts in September and not later than October. The housewife will readily see that the life of a Christmas tree in the home depends largely upon the heat to which it is subjected.

Crews of from two to fifty men are selected for the cutting, depending upon the area. In many places, Indians are employed in this work, as they are expert woodmen. A camp is established near the center of production —frequently a lumber camp is used—, and the crew is usually divided into gangs, each gang doing a certain part of the work. One gang consists of the cutters, who go ahead equipped with hand saws for table trees or axes for the larger ones, which are generally sawed off clean later. One slash of a sharp axe is usually sufficient for the experienced cutter to cut all but the largest trees. He also trims the trees, cutting out any dead, broken, or straggling branches or those where the squirrels have eaten off the tender tops. He leaves the trees where they are cut.

Another gang follows up, dragging the trees to an open space. Here the butts are sawed off and the trees are tied in bundles. The tiers straddle the bundles, thus pinioning them with their legs, and tie them with strong rope. In some of the larger camps, the trees are laid on wooden horses and in that position tied in bundles.

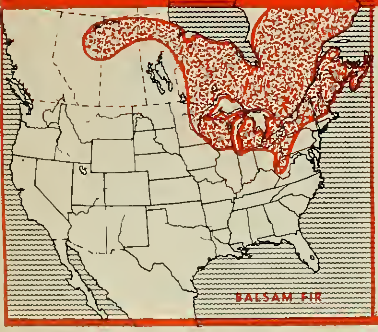
The bundles are piled up like cordwood. If the location is not adjacent to a road, they are "skidded" out to where they can be reached by truck or sleigh. If they can be conveniently left, they may not be taken out of the woods until time to ship. For the most part, however, they are hauled out of the woods on trucks, sleighs, or "drays" to the nearest railroad siding. Here they are piled up to await shipment. Where trees are taken from a wet swamp, a wide tracked caterpillar tractor and a steel boat or "dray" is used to get the trees to a truck road. On high land, horses or trucks are used.

The weather must be considered all through the season. The trees must be cut before hard freezing weather. If frozen, the cutters must hit several times instead of once to make the cut, thus losing valuable time. It is dangerous, also, as the axe can easily glance and injure the user. When frozen, the limbs are very brittle and will break as the tree falls, thus making the tree "lopsided" and unfit for sale. On the other hand, the trees must be removed from the woods before deep snows come, or they will be lost.

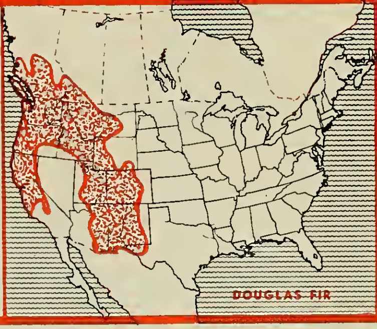
The shipping, in box cars or on flat cars, usually begins by November 15th. Trucks are used for the shorter hauls, a 3-ton truck carrying about 600 trees of average size piled high and securely tied. Box cars, which convey about one-third of the trees, can accommodate from 3000 trees to as many as 20,000 of the smallest sizes.

With so many trees being cut each

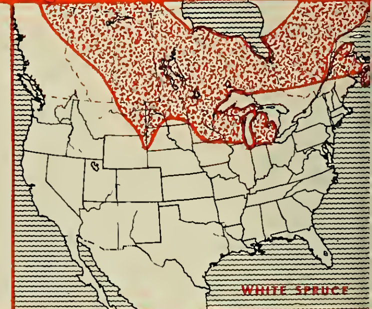
WHERE CHRISTMAS



Balsam fir seldom thrives as an ornamental. But the handsome white fir will grow from seed and is widely used from Va. north into New England



Small Douglas firs are hardy and attractive for ornamental planting in the northern, northeastern, and western states. Consult your nurseryman



Norway spruce, adaptable to eastern conditions, is a favorite. A northern exposure and moist, clay loam are advised. Or try white spruce year, the question of the depletion of the supply often arises. If all trees on any one plot were cut, there might be some danger of this. However, with good forestry practice, the number is likely to increase rather than to diminish. The proper cutting of small trees for Christmas use is not a menace to the forest, but on the contrary it is a means of improving the forest. By good forestry methods, the smaller trees are thinned out to give the larger ones a chance to grow into merchantable timber for lumber. As many thousands of small trees start out on an acre of land and only 500 to 700 will grow into large trees, it is a distinct saving to cut the remaining trees while they are small.

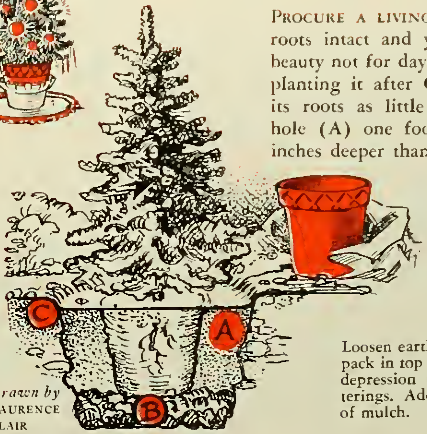
The Government Forest Service strongly condemns the practice of cutting trees promiscuously from places where their removal would mar the scenic beauty or where a valuable young forest is destroyed by cutting all the trees for quantity shipments. Trees cut under Forest Service supervision are marked with red tags upon which is printed: "This tree was cut in the —National Forest under the direction of the United States Forest Service for the improvement of the forest stand." On the reverse side is printed: "The prevention of forest fires through the past years has made possible this tree to decorate your home." A number of states have also printed certificates for properly cut Christmas trees. Insistence by the purchaser, either through certificate or reliable information, that a tree was cut in accordance with good forestry practice will help to discourage destructive cutting.

The state of Minnesota, which began in time to save much of its valuable timber, could double the present cutting without danger of depletion. Some private owners also attach tags to their trees to show that the cutting was not damaging. One of these tags reads as follows: "Greetings from the White Mountains of New Hampshire. This tree brings a Christmas message from the great outdoors. This cutting was not destructive. Forest Products Association, Inc., Groveton, N. H."

With the scientific methods of cutting now used, there will be plenty of Christmas trees for coming generations despite the fact that it takes five years for the average tree to reach a marketable height. But there is of course nothing to prevent one from growing one's own Christmas tree or using one with the roots intact and planting it after the Christmas season is past. Indeed, there is every reason both sentimental and practical in favor of this. The Christmas tree is an important symbol of our civilization, and it has a great life, while it lasts. If you plant it on your land, you will enjoy it that much longer.

HOW TO PLANT YOUR *Christmas Tree*

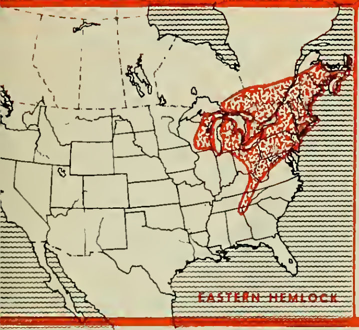
PROCURE A LIVING EVERGREEN with roots intact and you can enjoy its beauty not for days but for years. In planting it after Christmas, disturb its roots as little as possible. Dig hole (A) one foot wider and two inches deeper than the ball of roots

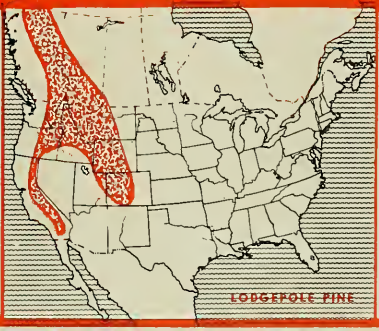


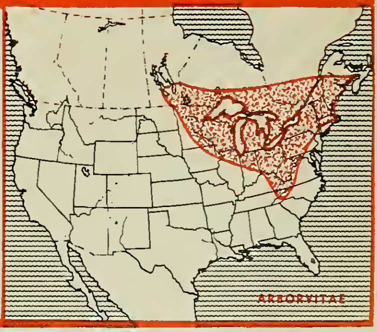
Drawn by LAURENCE BLAIR

Loosen earth at bottom (B), and pack in top soil leaving two-inch depression (C) for regular waterings. Add generous covering of mulch.

TREES GROW







EASTERN HEMLOCK ranks high among ornamental conifers. In the early years it grows slowly but is nevertheless good for borders and backgrounds

WESTERN PINE grows fast; eastern white pine thrives beyond its natural range and is our most widely planted tree. Both are strong and handsome

THE TRIM, decorative arborvitae is frequently cultivated, either from cuttings or transplanted seedlings. Your nurseryman will give details

ALUMINUM

By FREDERICK H. POUGH
Chairman and Acting Curator,
Geology and Mineralogy,
The American Museum of Natural History

ALUMINUM is a substance about which the army seems unable to make up its mind. In 1936 aluminum was placed on the strategic list; in 1940 it was moved back to the critical list. Yet it was the first metal on which formal priorities were invoked and the first substance for which a scrap collection campaign was instituted. It seems to belong on the strategic list. Certainly it will be of the greatest importance for the next few years, and for a time a considerable proportion of the ore we need will have to be imported.

Aluminum is one of the commonest elements. It is estimated that 7.3% of the earth's crust is aluminum, only oxygen and silicon being more abundant. The trouble is that these two other elements are usually combined with the aluminum in the form of a very hard mineral that is difficult to separate. The rock-making mineral group known as feldspar contains a considerable proportion of aluminum and is far more common even than our last strategic mineral, quartz.

There are many, many aluminum minerals, but only one that is used as an ore on a large scale. This is called bauxite, after the place in France where it was first discovered in 1821, Les Baux. Like a number of other minerals on the strategic list, it is the ore that is strategic, not the finished product, for we must import the ore, whereas we process it in this country. Also, there are several other uses for bauxite, some of which are as essential as the refined aluminum is for airplanes, as will be shown later. They consume 25 to 30% of the total tonnage.

Bauxite is not a single substance entitled to full rank as a mineral, like cassiterite or quartz. It is, rather, a mixture of minerals, hydrates of alumina. The minerals of this group occur as complex intergrowths, and it is difficult or impossible to separate them. More specifically they are known as gibbsite (with 35% water), boehmite and diaspore (both with 15% water). Generally, any given ore is a mixture, and there are usually other colloidal alumina-water mixtures with them. Naturally, bauxite is not an attractive looking ore, and the mixtures are usually shapeless masses of light reddish brown, claylike material. However, they sometimes show a series of small beanlike masses all cemented together, in which case they are said to have a pisolitic structure.

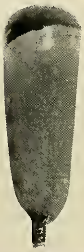
The origin of aluminum ore is very different from that of the other strategic ores we have discussed—different, indeed, from almost any other ore you might mention. Previously we have spoken of ore veins and magmatic differentiates, processes that imply igneous activity and mineral-rich waters emanating from hot centers. Aluminum ores did not form from such solutions, but from other rocks, by atmospheric weathering. They are very widespread, and it seems strange that anything so extensive could be strategic. But the fact remains that the United States and our ally Russia both have apparent shortages of workable aluminum ore.

The atmospheric weathering that produces bauxite deposits is not the normal type of weathering which can easily be seen wherever exposure to the elements has changed the color and composition of a rock surface. Analyses of the soils formed by this process in the United States show very few samples containing bauxite; one such was found in southern California. On the other hand, deep residual soils in the tropics have often been found to contain bauxite. The indication is, therefore, that bauxite cannot form in ordinary temperate climates but does so under tropical conditions of weathering.

The rocks from which bauxite is formed are commonly clays or an igneous rock poor in silica known as nepheline syenite. For an ordinary residual clay to become a bauxite deposit, some solvent action must remove the silica normally present, leaving behind the alumina. If the iron oxide is removed as well, so much the better; the ore will then be purer. Such deposits are known as laterites, from the Latin word *later*, meaning a brick, and they are sometimes a source of iron as well.

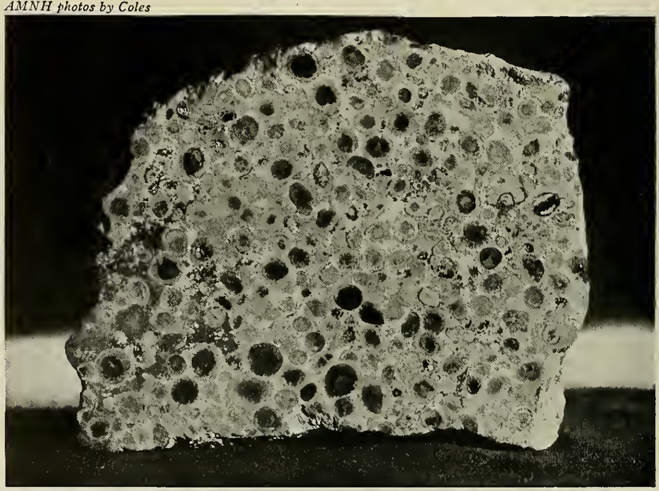
It has been seriously suggested that the explanation of bauxite formation might lie in the occurrence of frequent tropical thunder showers, causing nitric acid to accumulate in the soil where it could attack the silica. This is not a very likely theory, however.

It is immediately noticed that all



◄ **SYNTHETIC RUBY.** Delicate instruments pivot on bearings made from this aluminum compound. Non-metallic uses (refractory bricks, abrasives, cements, etc.) take 25% to 30% of the ore

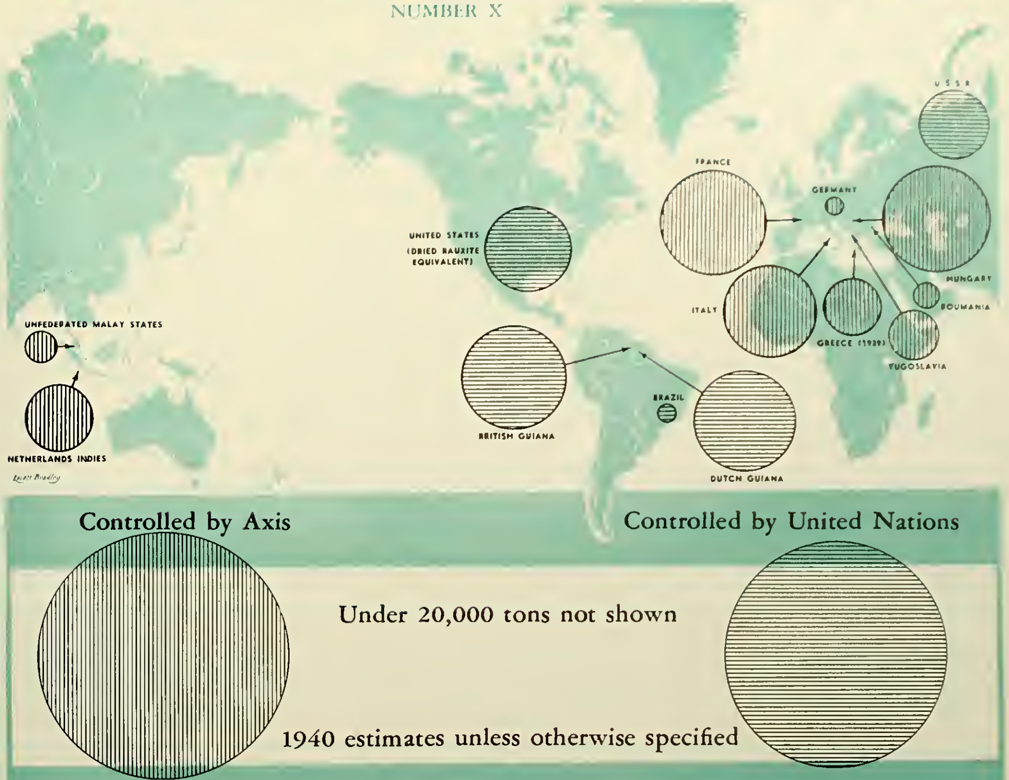
ALUMINUM is derived from claylike material that reveals none of the metallic luster we admire in the glittering body of an airplane. The most interesting specimens show many small beanlike masses all cemented together ▼



AMNH photos by Coles

STRATEGIC METALS

NUMBER X


U S S R
FRANCE
GERMANY
UNITED STATES (DRIED BAUXITE EQUIVALENT)
HUNGARY
ROUMANIA
ITALY
GREECE (1939)
YUGOSLAVIA
UNFEDERATED MALAY STATES
BRAZIL
BRITISH GUIANA
NETHERLANDS INDIES
DUTCH GUIANA
Controlled by Axis
Controlled by United Nations
Under 20,000 tons not shown
1940 estimates unless otherwise specified

Production of Bauxite

bauxite deposits do not occur in the tropics. In fact, none of the important Axis supplies do, with the exception of the deposits recently captured by the Japanese in the Netherlands East Indies. The Axis out-produces us, or did until recently, and all of their ores come from the temperate regions—France, Jugoslavia, Hungary, Rumania, and Greece. Some of these, at least, are residual deposits, like our own in Arkansas and Georgia which formed in an earlier geological time, when the climate was warmer in regions where it is now temperate and when tropical weathering was taking place in Arkansas. For some of the European deposits, entirely different methods of formation have been suggested, such as the reaction of solutions bearing aluminum sulphate upon limestone.

Attention must be called to one additional requirement for the formation of a bauxite laterite. It must not be carried away by subsequent erosion and deposited where it cannot be found. In this country, for instance, laterites that were formed in the Cretaceous and Tertiary periods have been eroded and distributed as sedimentary deposits. A vast area that might otherwise be considered suitable for bauxite on a basis of the underlying rocks is eliminated by the former presence of glaciers. No bauxite deposits are possible in the north where the intense scouring action of the glaciers has removed all unconsolidated weathered material. In the relatively short interval since the last slow retreat of the ice, the climate has not been propitious for a bauxite deposit to form there. Even now, we may be in what is merely an interglacial stage. For these reasons, we have to look to the south for our bauxite.

Production of aluminum in the world has increased rapidly in a very short time. The name comes from the old Roman term *alumen,* applied to any substance with an astringent taste; hence our word alum for potassium aluminum sulphate, originally applied in the Middle Ages. Alum was supposed to contain a metallic substance, whose oxide received the name alumina. Sir Humphrey Davy proposed the name aluminum for the metal, though he did not find it, and this name was accepted later. It subsequently became aluminium to the British and in most of the chemical textbooks, but Americans generally still adhere to the old form.

Finally, in 1827, Wöhler succeeded

in obtaining a powder of the metal. By 1862 the price had fallen from \$160.00 a pound to \$9.80 a pound, and by 1886 it was down to \$4.00. It was still too expensive, however, for general use. At about that time Charles M. Hall in this country and Paul Heroult in France, working quite independently and without knowledge of each other's work, discovered an electrolytic process for recovery of aluminum. This reduced the cost almost immediately to a very low figure, which has steadily fallen to its present price of 15¢.

Hall's process, which is in use today, was developed from Bunsen's successful experiments in the electrolytic production of aluminum in 1830. Aluminum chloride was mixed with common salt, and an electric current was passed through the mixture. Chlorine escaped as a gas, and the aluminum collected in small drops. The modern process uses cryolite (sodium-aluminum fluoride) as the solvent, which is less volatile than the chlorides and has a low melting point. When molten, it easily dissolves alumina. The cryolite is placed in a carbon-lined furnace, in which carbon electrodes are placed. A current is passed through them into the lining, melting the cryolite. When the latter is liquid, the electrodes are raised and alumina is added. The current breaks up the compound, and the oxygen combines with the electrodes, burning them away, while the heavier metallic aluminum sinks to the bottom as a liquid and is drawn off from time to time. The process is a continuous one, the electrodes being replaced as they burn away and fresh alumina added. Theoretically no cryolite is consumed, but actually a small amount of it is used up, and this is replaced. Cryolite might well be a strategic mineral, since all of it is imported from Greenland, where it occurs in a unique pegmatitic deposit, but it can also be synthesized from fluorspar, of which we have a more adequate supply.

The Hall process requires tremendous amounts of cheap electric power, 8000 to 20,000 amperes being used in the operation of the furnace. This requirement limits the amount of aluminum that can be produced as rigidly as does an adequate ore supply. However, new power projects in this country, notably the Tennessee Valley power and the Grand Coulee Dam, will be able to apportion considerable amounts of their current to new aluminum plants.

The main uses of aluminum are so obvious that it is hardly necessary to mention them. They largely depend upon its lightness, resistance to corrosion, and strength. For military purposes, only the purest and best quality aluminum can be used, hence much of the scrap is of no military value except in that it releases new production for war use by creating a supply of reclaimed metal for less critical civilian uses. But there are a number of special applications that are of interest. Thermite, the substance that starts an incendiary bomb, is a mixture of aluminum powder and iron oxide. It burns with tremendous heat, owing to the affinity of the aluminum for the oxygen, transforming the mixture into a mass of molten iron and molten aluminum oxide.

Aluminum cements, made from the ore, harden much faster than ordinary cements. Some refractory bricks are made from the ore; and a fusion of bauxite in the electric furnace will produce alumina that is useful as an abrasive. Aluminum oxide is the substance of which rubies and sapphires are made, and the manufacture of synthetic gems is an important use of bauxite. It is strategic in scope because the synthetic stones are used widely for the cutting of bearings for all sorts of instruments. The synthetic gem industry could be a chapter in itself. At the beginning of the war we imported all of our synthetic gems; today we are manufacturing an adequate supply, and after the war, we shall probably make our own synthetics for the jewelry trade. At present all synthetic corundum (aluminum oxide) is going into war industries.

In the 1930's Germany went deliberately to work to build up an aluminum industry, and at the start of the war was producing more aluminum than the United States. Our expansion of the past two years will more than wipe out this deficit, but it is too bad that this could not have taken place a little sooner. Despite the tremendous increase in American production, there will undoubtedly continue to be a wartime civilian shortage of this light metal.

Part of the shortage might be alleviated by the very recent growth of the production of magnesium, a still lighter metal. We have a serious shortage of bauxite ore. About half of it is imported from Surinam, or Dutch Guiana. Our deposits in Mississippi, Georgia, and Alabama are not large or important at present; most of the domestic ore is produced in Arkansas. The production there has been increased, but the deposits are not inexhaustible, and the day is not far off when all our bauxite will be gone. In anticipation of this, several steps are being taken, the most significant of which are experiments in the separation of aluminum from common clays.

Various other minerals have been tried or are being worked as aluminum ores. The Italians have produced aluminum and potassium for some years from leucite, a feldspar-like mineral which is abundant in some of their rocks. In Sweden, experiments have shown that aluminum can be produced from andalusite, an aluminum silicate, and the Norwegians have tried labradorite, a feldspar common in that country. The Japanese have experimented widely with alum shales, alunite, aluminiferous schists, clay, and phosphatic alum. In this country we, too, have worked with alunite, which is a potassium aluminum sulphate, with the idea of obtaining potash, sulphuric acid, and aluminum. Large deposits of it are known in the West, and it appears likely that the treatment of this mineral can be made a commercially profitable undertaking.

In summary we can say that the Axis appears to have no aluminum shortage, while we will remain, at least temporarily, dependent upon imported ores. It appears probable that domestic ores other than bauxite will eventually be developed to supply our aluminum needs from deposits within our own borders, so that the prospect is not a gloomy one. We have seen that self-sufficiency in mineral resources is almost possible to the United States, with substitutes available in most cases where the strategic material cannot be obtained at any price.

After we have won the war we can and must make sure that we never again can be forced to fight without sufficient stocks of raw materials to carry us for an extended period. More foresight could have accomplished this now. At the same time, we must also make sure that selfish monopolization of raw materials cannot serve as an excuse for later Hitlers to rise and try to impose an alien political philosophy upon a peace-loving world. While it is wrong to say that this is a war for raw materials, it is certainly true that a maldistribution of raw materials, coupled with a selfish monopolistic control, has served as the base upon which the Fascist pyramid has been erected.

WINTER SLEEP

Mason
WINTER
SUMMER
SPRING

By John Eric Hill

Drawn by

G. Frederick Mason

In the cooler climates, especially the North Temperate Zone, most mammals remain active all winter, but that is the time of their severest testing and many individuals do not survive the struggle. To remain active an animal must be warm, and even though mammals may be efficiently insulated from loss of heat by their thick fur coats, they must "burn," that is oxidize, large amounts of sugar, fat, and other food elements to produce the heat they require. They must eat more or richer foods, but during the winter there is much less food to be found. Leaves are no longer green; grass is buried under the snow and is dead; insects have died or are hidden under the leaf mold of the forest; and those that feed on small mammals find fewer of them, for they are sheltered under snow and reduced in number by the loss of their food supply.

Birds commonly migrate at this season when food is scarce, but mammals migrate only to a limited extent. Caribou trek from the tundra to the more sheltered forest; the wapiti come down from the mountains, and the animals that prey on them follow. Some mammals store food in caches and remain indoors on the colder days, emerging to feed and play in the warmer spells. And some put on fat, then curl up in a snug retreat, like the woodchuck, and sleep the winter away.

The different mammals that go to sleep in winter do not hibernate to the same degree. The squirrel family, for example, show many stages of winter sleep, from the red squirrel that may stay in his nest for a week of cold weather to the real hibernators, like the woodchuck and the ground squirrels. The chipmunk may stay out until November, but the woodchuck goes into his den much earlier, usually before September.

ON YOUR RADIO

Programs of the American Museum and Hayden Planetarium, Fall, 1942.

WEDNESDAYS over WNYC from 3:30 to 3:45 P. M.

Science For the Seven Million

•

FRIDAYS over the Columbia Broadcasting System from 4:30 to 4:45 P. M.

Exploring Space. Science in the sky.

What happens to a mammal that really hibernates? The body temperature, which is normally about 95° F. or higher, drops to only a few degrees above freezing—to 37° F. in the woodchuck. All of the processes of living are slowed down. Breathing is reduced to about one one-hundredth of the normal rate; the heart beats only seven to ten times a minute; very little oxygen is used by the tissues; and the intestinal movements slow down or cease. The muscles become stiff, much like the stiffness of death. However, warmth, loud noises, or light will disturb most hibernating mammals in a few minutes. Contrary to most expressed opinions, the mammal loses very little fat during the winter sleep.

What causes a mammal to hibernate? Cold, hunger, darkness, and quiet are important factors, but none of these is all-important. They do not cause a mammal to hibernate that does not do so normally.

HOW THEY GOT their names

By Roy L. Abbott
Professor of Biology, Iowa State Teachers College

History shows many strange changes in Nature's roll-call

Most of us know that when we eat Welsh rabbit we get cheese instead of rabbit, that the hamburger is not made of ham, and that hot cross buns may be cold, and chili soup hot. But few of us realize what a fascinating hodgepodge of inappropriate names many of our well-known plants and animals carry, or how often when we call them by their right names other people will not know what we are talking about.

Some of our familiar birds, of course, have fine names. No one, surely, will want to quarrel with such clearly descriptive names as bluebird, blackbird, cardinal, or woodpecker, or such obviously imitative ones as flicker, pewee, chickadee, killdeer, or bobwhite. These birds, because of color, voice, or habit, have, in a sense, named themselves.

The erectile feathers on its neck gave the appropriate name "ruffed" grouse to our fine woodland drummer; prairie chicken could hardly be improved upon for the grouse of our central states, although heath hen for the now extinct eastern form was equally good. "Red-tailed" hawk is another fine name, for the bird is red-tailed.

Hundreds of other names are equally appropriate. But coming close to home, those jaunty, brick-dust-breasted fellows which search for worms so commonly on our lawns are not closely related to the English, and original, robins. American robins are thrushes, as readily may be seen from the speckled breasts of the young ones, a feature common in greater or lesser degree to all young thrushes.

In the case of our "turtledove," which properly should be called "mourning dove," two mistakes have occurred. It is not the same bird as the smaller European species for which it was named, nor should the name "turtle" be applied to it. The Latins called the European form *turtur* because of its soft voice, and this was corrupted by our ancestors into "turtle." The fact that this misrendering of the word has been carried over into the English Bible has caused much confusion. For in the Song of Solomon we read that "the voice of the turtle was heard in our land," and this, to the devout but uninformed, can mean only the vocalizing of the reptile of that name.

Our orioles turn out to be blackbirds. True orioles (a group of birds related to the crows) are not found in North America. Our Baltimore oriole should have been just "Baltimore bird," as Catesby called it in 1731. The Baltimore part is correct, for the bird's gold and black match the colors of Lord Baltimore, for whom it was named. Also we discover that our warblers are different from the European birds of that name. Nor does the name "Bohemian" tagged to our beautiful waxwing fit very well, for this species was not derived from central Europe as its name implies. Still less fitting is the name "turkey" for our fine Thanksgiving bird. The turkey really hails from Mexico but had to be carried to Europe by the Spaniards to acquire the wrong name by which we know it.

Our habit of piling name on name is illustrated by our great brown cat, the American puma or cougar, which the early colonists called "panther," the old Greek name for leopard. The Yankee woodsmen soon corrupted this name to "painter," and this splendid animal now bears the additional names of "catamount" and "mountain lion." The birds, however, bear off the palm for multiplicity of common names. The coot or mud hen, for example, is known under 24 different names, and the name "coot" is also applied to half a dozen other species as well. Sixty-five different hunters in various parts of the United States could each shoot a ruddy duck and each rightfully call it by a different name. But the flicker really captures first prize, for it is known by at least 127 vernacular names.

The plant-namers have not been less active. East of the Mississippi and north of the Ohio, 15,000 common names have been distributed among only 4000 plants. Though the French were in Canada and the Spanish in Mexico years before the coming of the English, most of our names for native plants and animals are of English origin. And since language is not made by the educated but by the common people, the majority of our conspicuous birds and mammals and plants were named by men who were often careless with words and usually ignorant of zoology and botany. We may say that theirs was an honest ignorance, for what with Indians to fight and a raw country to subdue, they had little time to bother about getting the strange plants they saw or the animals that ran or flew about them into their proper groups. They simply had to have names for these things, so if an animal or plant looked like one they were already familiar with back home, they called it by the name they knew, often adding the term "wild" to distinguish it. This simple method readily disposed of dozens of species, of which wild ginger, wild oats, wild goose, and wild pigeon are commonplace examples. False indigo and false strawberry are other examples of a long list of plants in which the term "false" distinguished the species from similar forms.

Indian names

If the colonists had never seen the plant or animal in question before coming to this country, they sometimes adopted the Indian name for it. This brought into our language such useful and time-honored names as pecan, persimmon, and chinquapin, as well as woodchuck, moose, skunk, opossum, and raccoon. One might wish that they had followed this plan further. Indian pipe, Indian potatoes, and Indian corn are pertinent examples of a hundred or more plant names in which the word Indian appears. This was done, sometimes disparagingly, to indicate plants used by the red men.

More often, however, particularly when compelled to invent a name, they usually called a plant after something that it resembled or after the animal which ate it, such as bloodroot and catnip. Many more plants—all in the Indian doctor's materia medica—got their names from ailments they were supposed to cure or cause; hence ague root, pleurisy root, and ninebark, the last being a sort of cure-all.

Upwards of a hundred plants were rightly or wrongly thought to be bad for animals, such as dogbane, cowbane, henbane, and fleabane. And 70 or more species were named for snakes, none of which, however, had anything to do with snakes except by way of suggestion, say, in appearance.

Strangely enough, of the 65 plants named for the dog, not one of them compliments man's best friend. None of the several dogberries, for example, are edible. Less strange, perhaps, is the fact that those names referring to the hog all express insignificant or disagreeable qualities. Names prefixed by the term "horse" or "bull" usually indicate large or coarse forms, pertinent examples being horseweed, horseradish, bull thistle, bullfrog, and bull-bat.

Sometimes the namers reversed the procedure and named the animal for the plant. Familiar examples of such really appropriate names are woodpecker, cedarbird, tree toad, potato bug, and tomato worm.

In those early days, heaven was seemingly nearer the heads of men than now, and hell much closer to their feet, hence we should not be surprised to find both Satan and the Saints coming in for their share of names. Although not always appropriate, no less than 30 of our common plants carry the name of the devil, familiar examples being the devil's-paintbrush, devil's-club, devil's-horn, and devil's-grandmother. Among the animals, he is remembered in such names as devil-down-head for the nuthatch, devil's-darning-needle for the dragonfly, devil's rear-horse for the praying mantis, and, by implication, hell-diver for the grebe.

All of these animals are harmless to man, and even among the plants, legend has it that those known as "devil's-bites" have their names from the fact that their blunt rootstocks indicate that the devil had bitten them off out of spite for their medicinal qualities.

Among the saints, St. John appears to have been most popular with the namers of plants, for in a list of 96 British plant names, his name occurs sixteen times. It was formerly the practice to name a plant in honor of saints in order to gain their favor. This custom had fallen into disuse about the time of our beginnings as a nation, which accounts for the fact that many such names known in America were imported.

When is a gopher not a gopher?

But we cannot lay all credit or blame to the New Englander. Down in Florida they still call a certain stork an "ibis," in spite of the fact that they do have real ibises there which they call "white curlews." Also they call both a snake and a kind of burrowing tortoise a "gopher," a term applied elsewhere to a small burrowing animal about the size of a mole. Yet with consistent and delightful inaccuracy, the Floridians call their pocket gopher a "salamander" —a cold-blooded creature related to the frogs—and one of their true salamanders, a "congo eel." An eel, of course, is a fish.

And so this popular game of calling and often miscalling things goes gaily on. Whoever is responsible, most people continue to dub all insect larvae as "worms," although they are not worms. A common little worm found in ponds and creeks is usually called a "horsehair snake," although neither a snake nor an animated hair. And the loud, harsh-voiced cicadas which sound like buzz saws in our trees in summer will probably remain "locusts," although that name is properly applied only to short-horned grasshoppers.

Fishermen call our big-eyed perch, the "wall-eyed pike," the shovel-nosed sturgeon, a "spoon-billed catfish," and any small fish to them, is always a "minnow." Indeed, the common names of fish are so numerous and so chaotic that fishermen in the several states, even though catching the same varieties of fish, hardly speak the same language in talking about them. To remedy this, the American Fisheries Society has set out to standardize the popular names of common fish. If they have their way, the big-mouthed black bass will no longer become a "green trout" when caught south of the Mason and Dixon's line, and the Massachusetts sportsman in Minnesota won't dare say he caught a "horned pout" when it was only a bullhead, or to the southerner, a catfish.

The scientific method

Since 1773 biologists, following the example of Linnaeus, have attempted to escape this multiplicity of common names by giving to each distinct kind of animal or plant a so-called scientific name in Latin or often Latinized Greek. Ideally, a name once given would be the same the world over, and would remain the same. Each animal or plant would have a name composed of two parts, the first part designating the group or genus corresponding, say, to Jones among family names, and the second part being the specific or given name—John, for example. Man's scientific name is *Homo sapiens,* that of the dog is *Canis familiaris.* Scientific names are written in the opposite order from ours, which is quite sensible, for it puts the important part first.

This system not only names things but it groups them as well, for all species under the same genus have the same first name. But it must be admitted that some of these scientific names are badly chosen too; and in spite of the good intentions of the scientists, such names frighten people at first sight, though we unwittingly use some of the hardest ones when we pronounce such tongue-twisters as chrysanthemum and rhododendron. Most of us are being unknowingly scientific when we use such familiar words as asparagus, begonia, magnolia, dahlia, and geranium, for each of these is the first part of the scientific name of the plant mentioned. Some of us, also, may be surprised to learn that fuchsia and magnolia, respectively, to mention only two, honor the memory of Fuchs, a great German botanist, and Magnol, an early French student of our flora. And who does not unhesitatingly say "boa constrictor"—the whole scientific name—when referring to that snake at the circus or zoo?

Jaw-breakers

If we had never known any other names, each of us, perhaps, could use the scientific names as readily as we now use the common ones. But when we come across such a jaw-breaker as *Citellus tridecemlineatus,* which is the scientific name of the little thirteen-striped ground squirrel of the central states, many of us will doubtless shake our heads and go right on calling the animal "grinny," "gopher," "flagtail," or "whistling streak," depending largely upon the locality and who saw it last. Indeed, scientific men have often given names to things long before they understood clearly what they were naming. When the Englishman, Robert Hooke, squinting through his crude microscope nearly three centuries ago, first saw the finer make-up of a piece of cork, he called the tiny units composing it "cells," because they looked to him like little rooms, and that name has stuck—possibly because it is short and easy to say—in spite of the fact that every college freshman knows that Hooke was dead wrong. They are not box-like, hollow things at all, at least in animals.

Much the same may be said for that oft-repeated word "vitamins." When first discovered, chemists thought these important substances belonged to a group of known compounds, the amines, and being shown to be necessary to life, they were accordingly called "vita-amines." Yet now that we know that some of them are not amines, we still call them vitamines. The "vita" part, however, is still meaningful, for we cannot live without them.

What are we to do then with our flying foxes which are really bats, with our gar pikes which aren't pikes, and with our glass snakes, which are lizards, and with our bald eagle, which is not bald but merely white-headed?

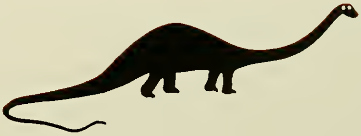
Why, go right on calling them what we have always called them, to be sure. For the average person probably feels toward this idea of calling familiar things by other names than those to which he is accustomed, very much as the Baltimore *Sun* feels toward the campaign to change the speech of the New York school children. It is a "downright useless expenditure of effort; if it succeeded, it would be destructive of color and vitality," says the *Sun*. To pronounce "bird as *boid* and verse as *voise*" . . . is what makes "Brooklyn interesting and stimulating to the rest of the country."

We get along fairly well even if one hunter does call his duck a pintail, while another says his is a "sprigtail" or a "spiketail," and it does give color, freedom, and variety to our speech. Must we change Buffalo Bill to "Bison Bill" because that great hunter never slew a buffalo in his life, but only bison?

When is a thrush not a thrush? When it is a Louisiana water thrush, a true wood warbler, answers the scientist. But for most of us, it will remain a water thrush for all that, just as our big red-breasted thrushes will continue to be robins. Scientists will eventually agree upon one scientific name for each life form, and many of the common names which have not been much used will gradually be dropped from the records, as they should be. But great numbers of them, even though they do not fit, are here to stay.

Hence, for most of us, when we go for a stroll, the dogtooth violets will be just that and none the less attractive in spite of the fact that they are not violets but lilies; and the New England aster for many will still be the "last rose of summer." Mountain ashes and prickly ashes will remain so, even though they are not ashes, and our calla lily will still be lovely and still a lily though really it is a close relative of the jack-in-the-pulpit. The orioles or hangnests will be no duller of color though they actually be cousins of the blackbirds. The poison oak will irritate our skins just as effectively though it be poison sumac, poison ash, or what you will! Most of us, too, will see no contradiction in terms when we say we saw some yellow or white violets, or that blackberries are red when they are "green"—meaning, of course, unripe.

THE DI-PLOD́-O-CUS



Perhaps the poor Di-plod′-o-cus
Should not bear all the blame;
He had no chance to spare himself
So difficult a name!

Yet, since he stood fourteen feet high,
And more than eighty long,
Some other names for him could sound
Embarrassingly wrong.

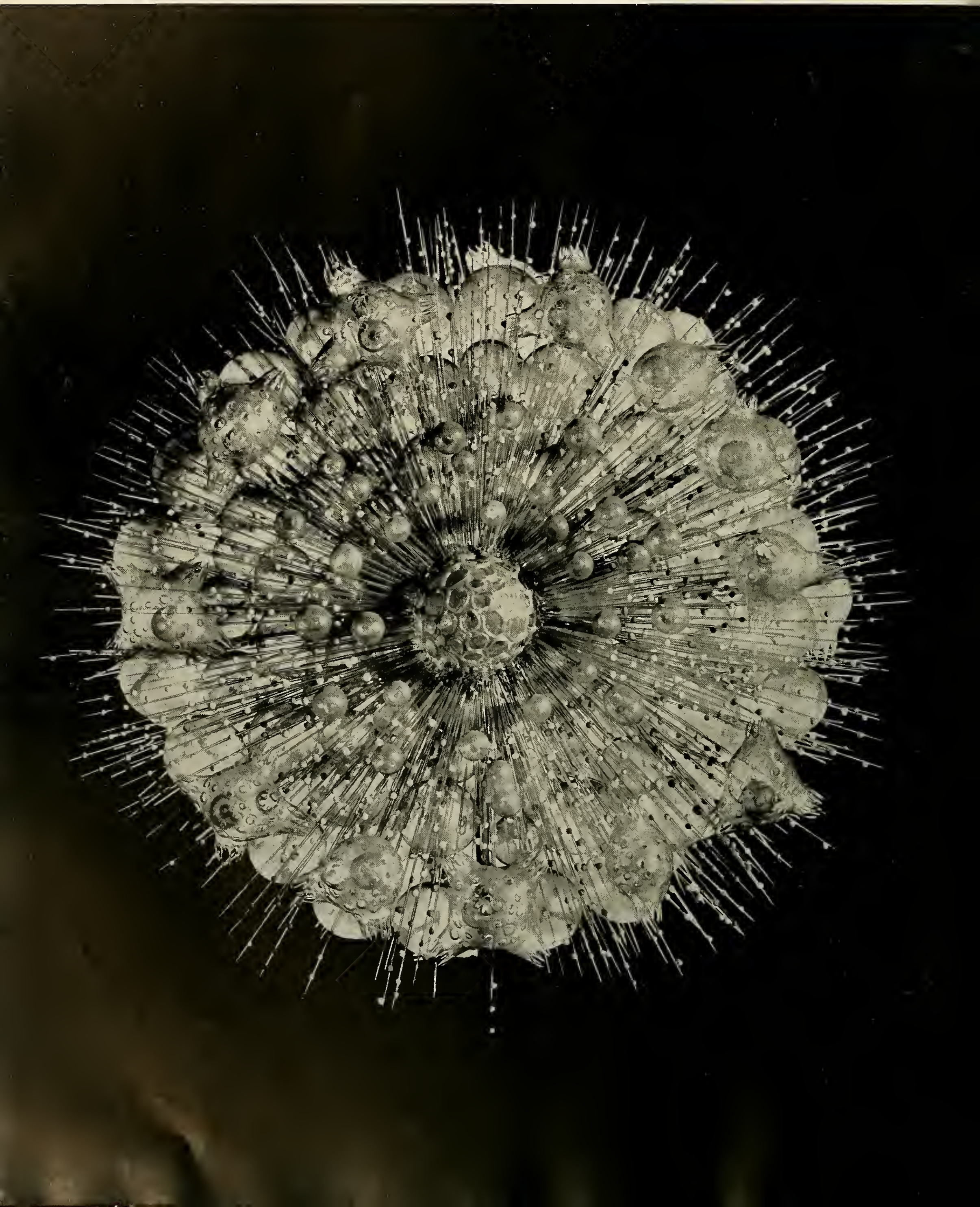
His legs were tall, his body short,
His tail too long and fat;
Upon a neck nine yards in length,
His head was small and flat.

And so it probably was best,
And saved a lot of fuss,
To give the creature, as they did,
The name, Diplodocus.

(P. S.: Since there was more than one
Such prehistoric whopper,
To speak of Di-plo-doc′-i-dae
Is altogether proper.)

— Maud Mero Doolittle.

▼ A MINUTE SEA-CREATURE *(Trypanosphæra regina)*: one of the Radiolaria. These tiny animals construct a skeleton of natural glass from the silicon dissolved in sea water. The nucleus, which directs the life-activities of the creature, is contained within the latticed sphere in the center. The photograph is of a glass model representing the animal highly magnified, constructed by Herman Mueller, the Museum's skillful glass-modeler



Universe Through a Microscope
The *Protozoa*

By ROY WALDO MINER

Curator of Living Invertebrates,
The American Museum of Natural History

Tiny creatures that swarm by the million in water everywhere. A world invisible to the naked eye but of great importance to mankind

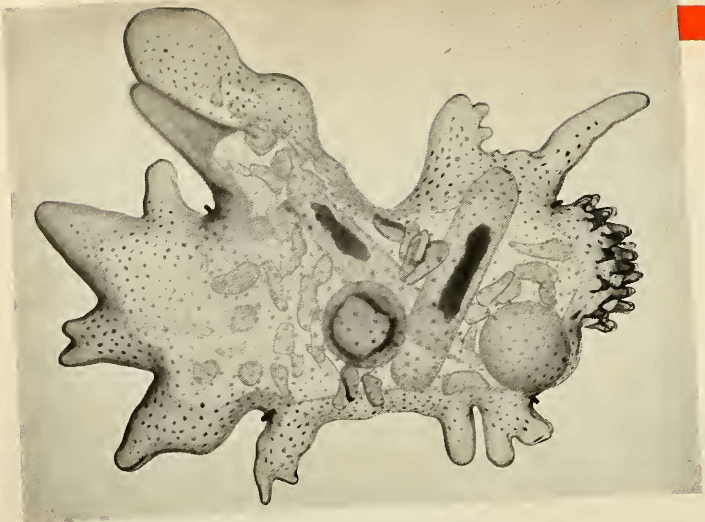
PHOTOGRAPHS BY CHARLES H. COLES, *American Museum*

IN this world of struggle between millions of human beings, it is hard to realize that, invisible to our eyes, another world composed of billions of organisms is pulsing with complicated life activities in our very midst and carrying on a struggle that has continued through eons of time since long before man, or, in fact, all other animal life, came into existence. The invention of the microscope, three centuries and a half ago, created a window through which the great naturalists of that time were able to peer into this universe of minute creatures hitherto totally unsuspected by mankind.

Conspicuous in this microscopic life are the teeming Protozoa. With their minute bodies consisting of but a single cell, they were among Nature's first experiments in animal life. Yet the ancient trial was a success, for they still live and penetrate all the zones of existence. They inhabit the earth from the equator to the arctic regions, from the highest mountain tops to the deepest abysses of the ocean. Wherever there is moisture they exist, and, in their resting stages, they bide their time in desert places. They swarm over aquatic vegetation and multiply in pond and stream. They float in the open ocean by myriads

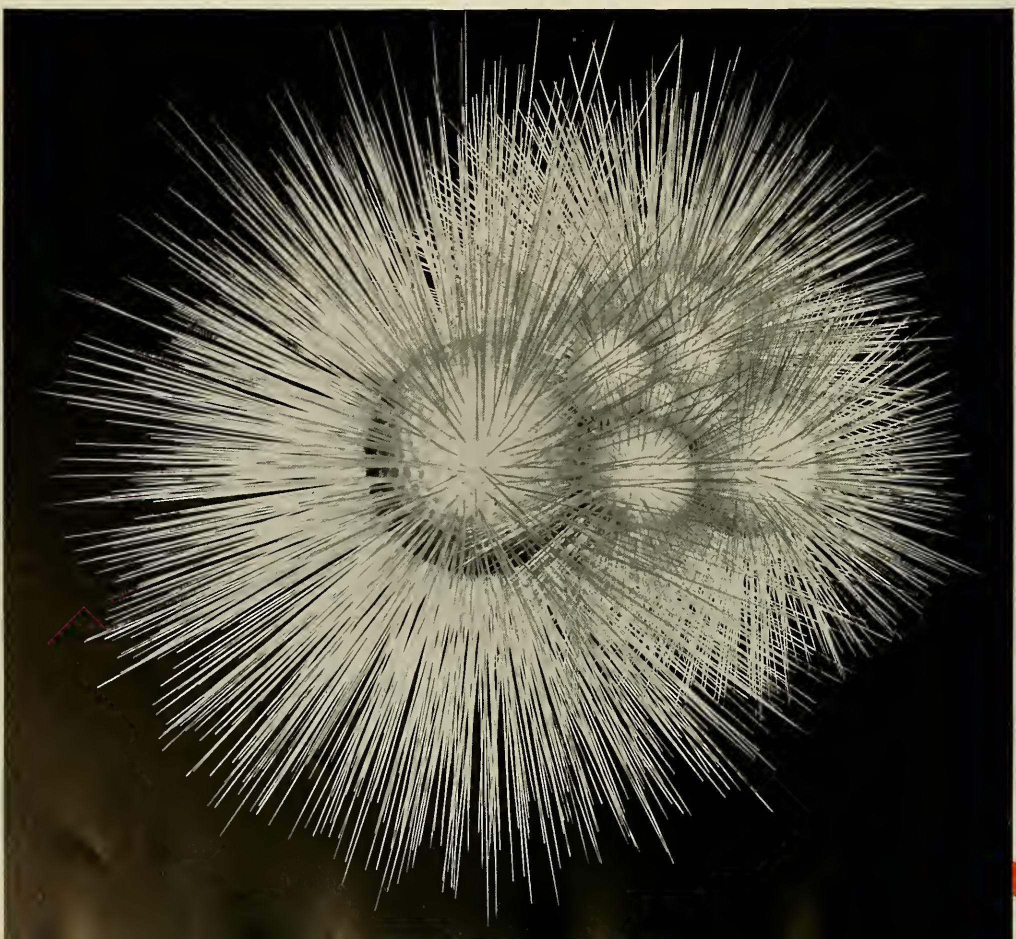
▲ LOOKING THROUGH the microscope into an otherwise invisible world, Doctor Miner selects the tiny creatures from which greatly enlarged models are to be constructed in glass for the American Museum's exhibit of Protozoa. Each animal must be carefully studied and drawn before this is possible. Skilled artists are used for this purpose

◄ HERMAN MUELLER, the Museum's wizard in glass, exercises his remarkable skill in modeling countless delicate structures over a hot flame to produce his wonderful protozoan models

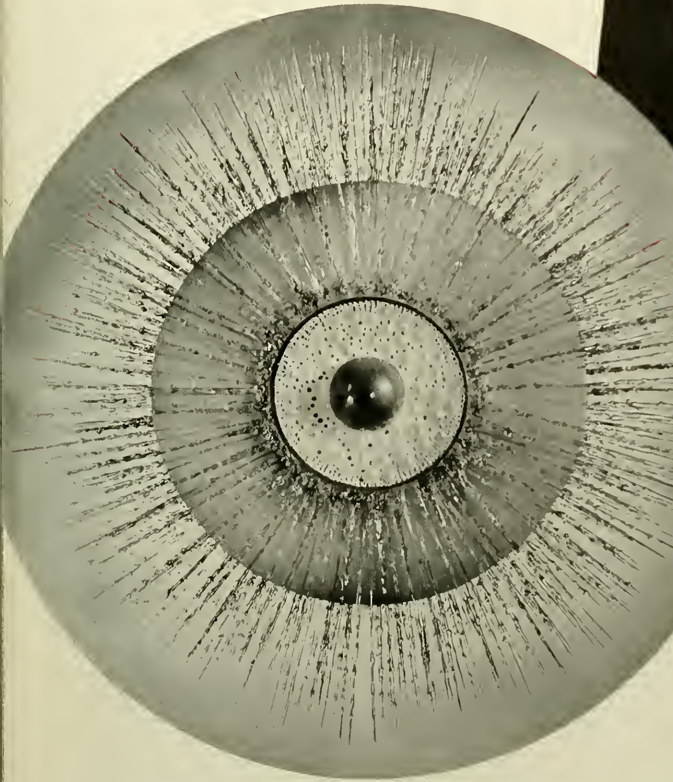


◂ ONE OF THE SIMPLEST of all living animals, the microscopic single-celled *Amoeba* resembles an irregular mass of living jelly, moving about by extending finger-like projections of its substance and flowing into them. The round nucleus is visible near the center of the body. A bubble-like "contractile vacuole" at the right is about to expel detritus into the surrounding water. This model, like the others, is of glass and represents the animal highly magnified. The *Amoeba* is common in fresh water

▾ UNLIKE the related naked *Amoeba,* the *Globigerina* builds a many-chambered shell of limestone. These creatures are so numerous, floating in the open sea, that, when they die, their shells gradually accumulate on the sea bottom, forming beds miles in extent. These often solidify into rock. Geologic changes may elevate them above the surface to form limestone cliffs like those of Dover, England. Thousands of related species are known, which build shells in great variety of pattern. Many are fossilized, and among them are certain species found only in oil-bearing rocks, so they are of importance to oil geologists as aids in locating oil deposits. Note the great number of delicate needle-like bodies that had to be set carefully in position on this model



➤ THE PROTOZOAN *Ceratium,* with its peculiarly shaped glassy shell, is particularly abundant in tropic seas, where, at night, the luminescent bodies of these tiny creatures cause the sea to glow in the foaming wake of moving vessels, or when the water is disturbed by oars



▲ THIS BEAUTIFUL CREATURE is among the simplest of the Radiolaria. Whereas most species of the group are equipped with glassy shells, the *Actissa princeps* is shell-less. The spherical nucleus is centrally located within the membrane of the central capsule, while threadlike pseudopodia ("false feet") extend in all directions to secure food

and their fossil shells form the substance of continental rocks. Finally, they penetrate the tissues of all other animal life and gain their livelihood in the intestines and blood stream of the highest animals, including man. While carrying on this part of their career some feast upon man's very tissues and organs, causing many of the most serious of his diseases and culminating in epidemics more fatal than war. Who knows but that Nature's first life experiment may well be her last and that the legions of primitive one-celled creatures that achieved the earliest steps in evolution may finally triumph over the boastful race that fondly imagines it has achieved the summit of evolution, namely, Man himself?

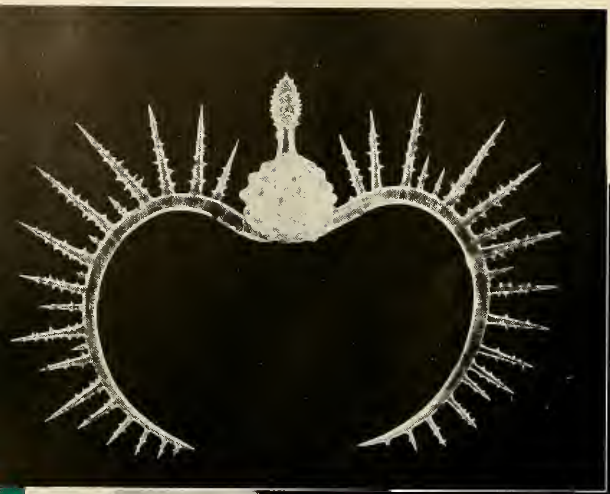
The Protozoa are spoken of as *single-celled animals.* That is, their entire bodies are equivalent in size and living substance to one of the millions of microscopic cells that make up the tissues constituting the organs of our bodies. But there the resemblance ends. For each protozoon is a complete and independent animal, performing within its minute single cell all of the functions that require our entire cellular complex to accomplish.

Within the protoplasm enclosed by its cell boundaries, the protozoon provides for sensation, locomotion, feeding, digestion, assimilation, growth, breathing, excretion, and reproduction. Our enormous equipment of cells is made up of specialized individuals arranged in tissues, which, in turn, are grouped in organs, each with a special function. A muscle cell can do nothing but contract. A digestive cell can only secrete. A nerve cell can only transmit sensory or motor impulses, and so on, all other functions being lost or reduced.

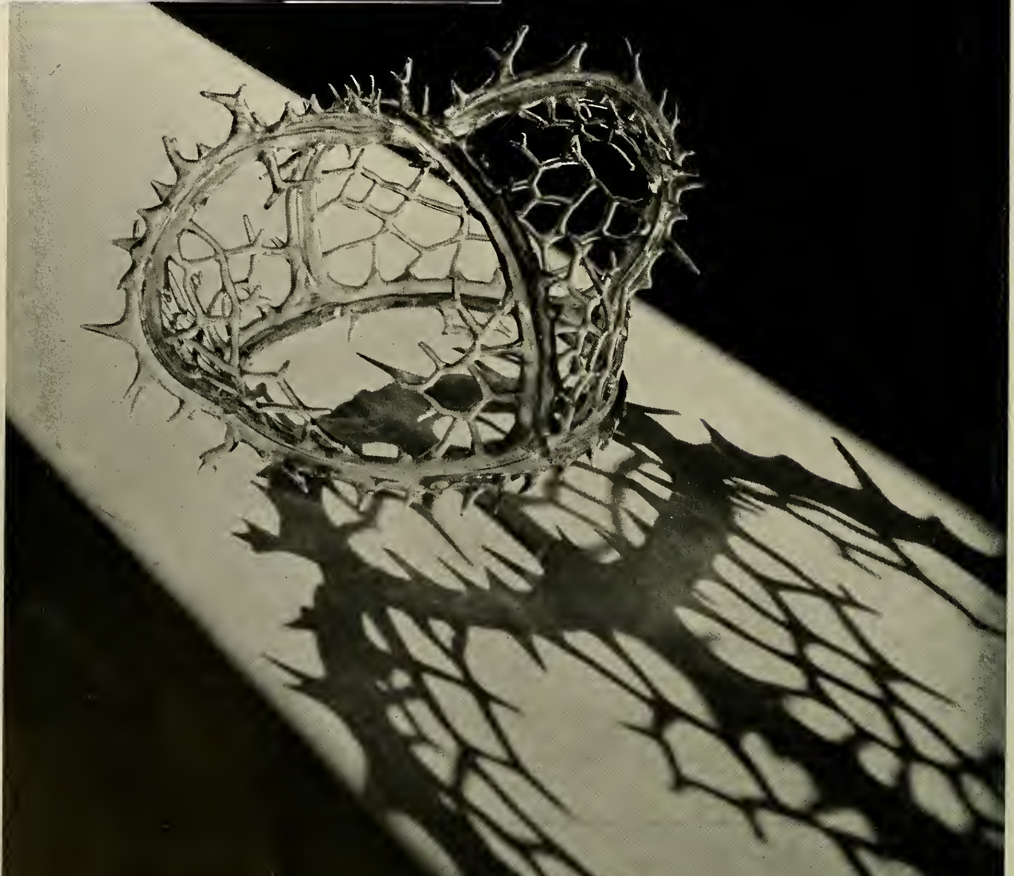
A cell is thus a living protoplasmic entity. In many-celled animals (Metazoa) it is the living unit of structure, while in single-celled animals (Protozoa) it is the entire living organism. The protoplasmic substance of the cell consists of two main portions, the nucleus and the cytoplasm. The former is a rounded, ovoid, or sometimes variously shaped body of greater density than the cytoplasm. It controls the activities of the cell, including the reproductive function. The cytoplasm is the clearer substance composing the rest of the cell, containing various bubble-like vacuoles having to do with digestion and excretion, as well as other inclusions of varied significance to the cell.

The Protozoa are divided into four main groups, which, however, blend at their boundaries through intergrading types, thus showing their fundamental relationship. These are the Rhizopoda, Mastigophora, Sporozoa, and Ciliata.

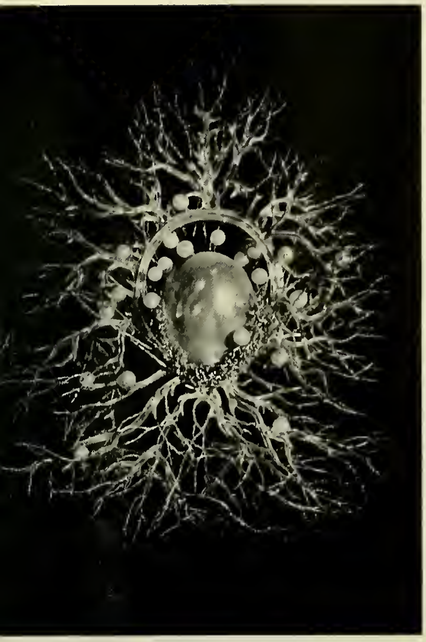
The Rhizopoda have bodies without regular shape from which they extend club-shaped or threadlike portions of their substance and flow into them in order to move from place to place. They also utilize these projections to secure their prey, which they engulf at any part of their body surface. They may be naked or equipped



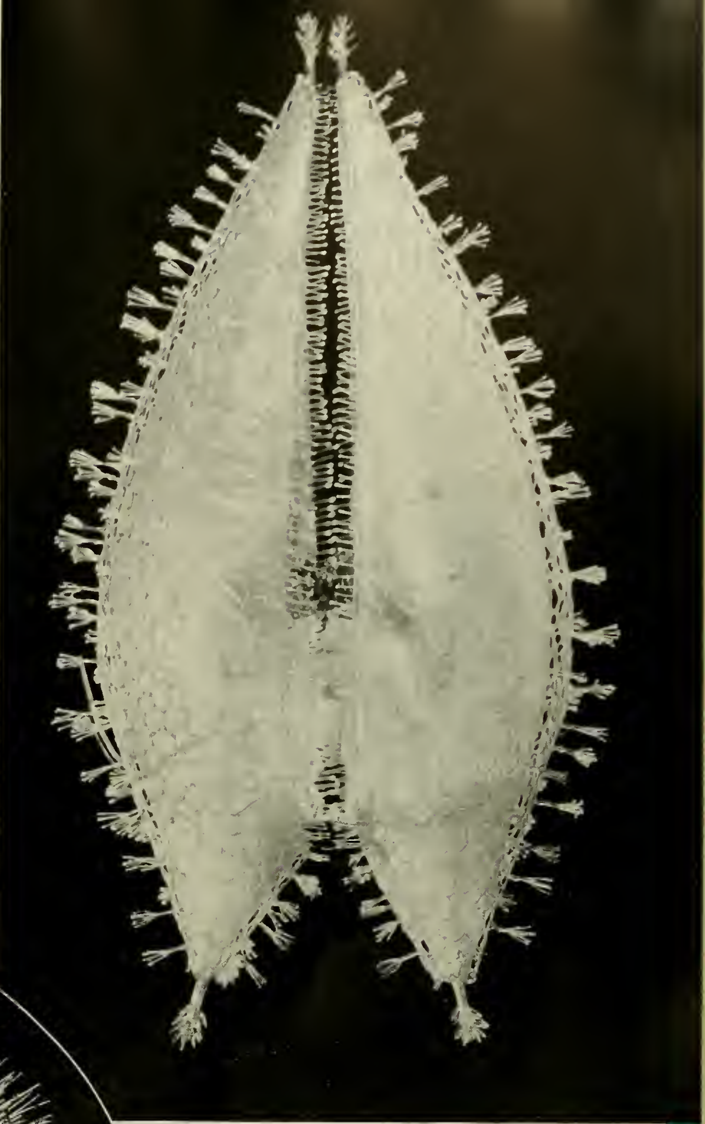
Radiolaria produce an almost infinite variety of shell forms. *Dorcadospyris dinoceras,* at left, though a gem of microscopic beauty,possesses a pair of menacingly spiked horns, as its scientific name indicates, that would be terrible if borne by some gigantic prehistoric monster. Actually, the creature is only about the size of a sand-grain



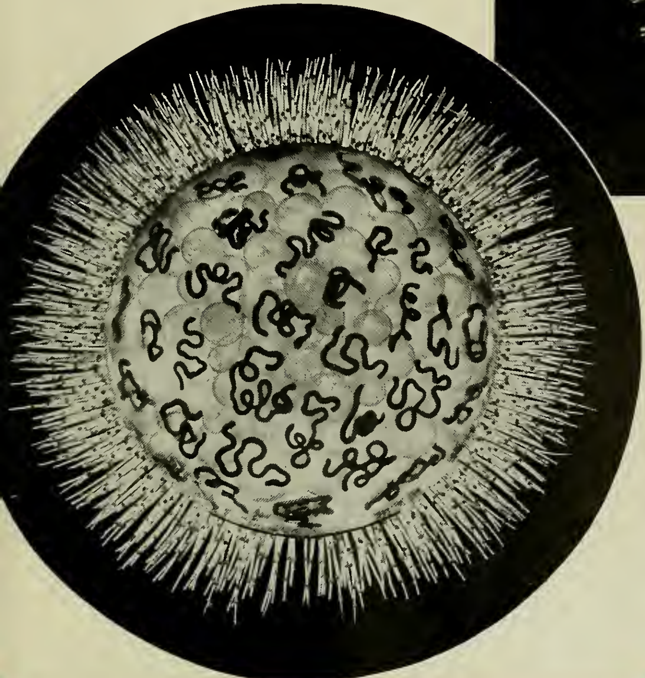
▲ Many of the Radiolaria achieve patterns of extraordinary beauty in their crystal shell formations. *Acanthodesmia corona,* though almost literally a "crown of thorns," as its name indicates when translated, has shaped its glassy spikes into a graceful diadem. The models shown here are all on display at The American Museum



▲ THIS is one of the most remarkable of the Radiolaria. *Lithocircus magnificus* has formed a vertical crystal hoop, with branching treelike antlers extending in all directions. The rose-colored central capsule housing the nucleus is seated in this frame, showing a curious cone-shaped structure through its transparent wall

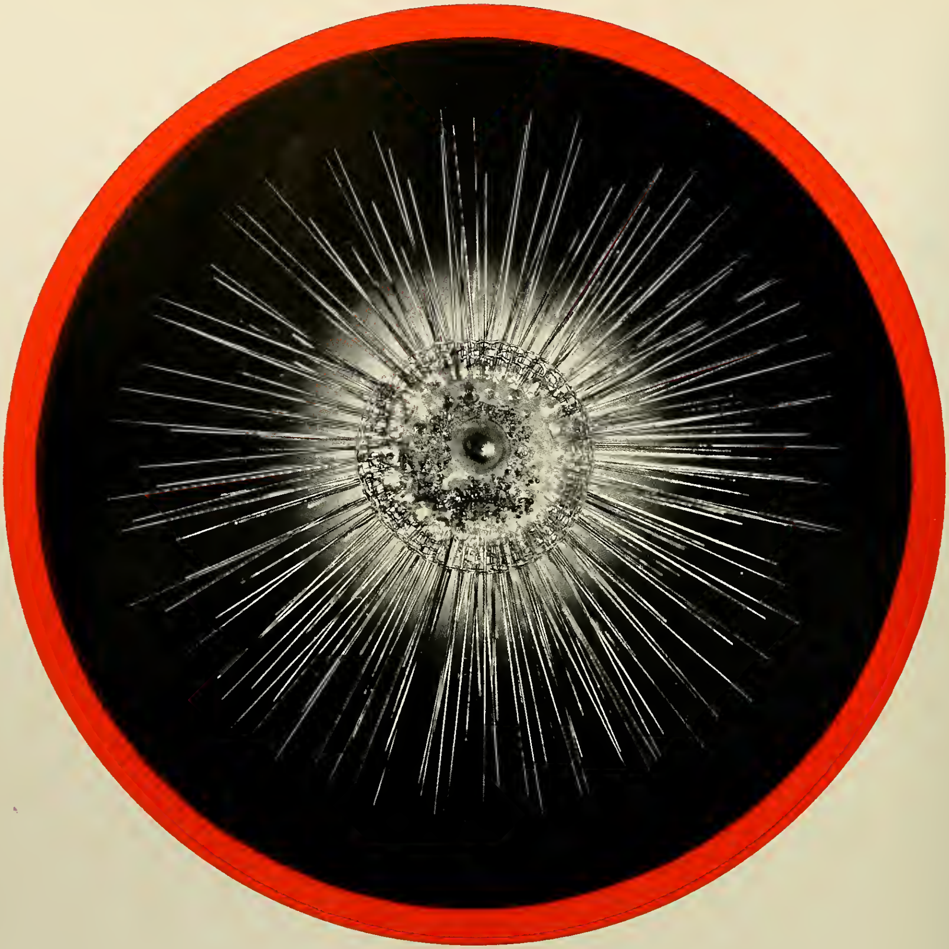


▲ THIS SPECIES *(Coelographis regina)* might well be called the "Queen Radiolarian." It is one of the most highly specialized forms of the group. Between its graceful mitre-like shells is enclosed a complicated central capsule with branching tubelike structures, while the outer surface is a delicately wrought mosaic of lacework. Incidentally, this is a triumph of glass-modeling technique, being one of the most difficult of Herman Mueller's achievements



◀ THE SERPENTINE RADIOLARIAN *(Collozoum serpentinum)* is a colonial species, made up of many individuals, each with a scarlet, serpent-like nucleus. They surround a central bubble-like mass from which the protoplasmic filaments of the colonial pseudopodia project in all directions

▼ THOUGH not as huge as the Queen Radiolarian, nevertheless the *Aulonia hexagonia* is of good size, being 1/8 of an inch in diameter. It is enclosed in an almost perfect sphere of glass lacework made up of multitudes of hexagonal meshes. It is found floating in abundance at the surface in the tropical Atlantic



with shells of tectin, carbonate of lime, or silicon. Some of these are simple, while others have successive chambers arranged spirally or otherwise. Many show delicate and complex patterns.

The Mastigophora ("whip-bearers") are distinguished by a usually more definite body form, and by one or more flagella, or flexible whips, with which they lash the water and thus move rapidly from place to place. Some form colonies, while others are parasites, causing diseases dangerous to higher animals and man.

The Sporozoa are internal parasites on larger animals. They are of simple form and reproduce by means of multitudes of spores. Hence the name. Some of these also are the source of serious human diseases.

The Ciliata are so called because their bodies are covered with numerous closely set cilia, or hairlike projections, much smaller than flagella, but, like them, used for propulsion. They have a more complicated nuclear apparatus and much more specialized structure than the other groups. They are mostly free-swimming organisms and, in certain species, reach a higher degree of unicellular specialization than any other Protozoa.

Each of these four groups has followed its own particular road of evolution, starting with comparatively simple types that show evidences of relationship to the other groups and then evolving more specialized forms peculiar to each group.

Among the displays in the Darwin Hall of the American Museum of Natural History, there is an alcove devoted to the Protozoa, in which may be seen a series of glass models accurately portraying these organisms on a highly magnified scale, beautifully wrought by the Museum's skillful glass modeler, Herman Mueller, under the writer's direction. Outstanding examples of his work are depicted in this article.

Here, some of the most typical Rhizopoda are shown, beginning with the primitive *Amoeba* with its naked irregularly shaped body, through the transparent walls of which may be seen the oval nucleus, the bubble-like contractile vacuoles, the food vacuoles, and other internal features. The Foraminifera have bodies like *Amoeba,*

▲ *Paramecium caudatum* is a member of the numerous and specialized ciliate protozoans. Its body is shaped for rapid motion, being propelled by multitudes of tiny hairlike cilia, which cover its surface

but equipped with protective shells of limestone, the most conspicuous of which (*Globigerina bulloides*) is represented by a beautiful model. This organism floats by the million in the open ocean and, when it dies, its tiny spiral and spiny chambered shell sinks slowly with thousands like it to the sea-bottom, where they accumulate as Globigerina ooze in banks hundreds of feet in thickness and many miles in extent. During past ages, many of these banks have hardened into rock and, in some cases, through geologic changes, have been raised above sea-level to form continental limestone cliffs. The chalk cliffs of Dover, England, were formed in this way.

Other microscopic marine creatures of tropic seas are the Radiolaria. These manufacture their lattice-like "skeletons" from natural glass, i.e., silicon, with a chemical formula closely akin to that of opal. They are wrought into patterns of unbelievable delicacy and beauty. A fine series of glass models in the alcove exemplifies the intricate variety of these. Like their lime-producing relatives, the glassy skeletons of the Radiolaria are extensively deposited in beds of siliceous ooze on the ocean floor, forming a fine, flinty sand, which, under the name of Barbados earth, is used by jewelers as an abrasive for polishing and grinding precious stones.

The radiolarian animal, like the other rhizopods, extends pseudopodia from all parts of its body, radiating like delicate filaments to form a trap in which other organisms are caught. These are entangled by the filaments, which surround them with protoplasm and draw them toward the central organism, digesting them as they do so. The radiolarians are also complicated in having an oval central capsule within which the nucleus is contained. Foamlike bubbles between the protoplasmic threads have a hydrostatic function, enabling the animal to expand along the radiating bars of its glassy skeleton, thus reducing its specific gravity, so that it rises toward the water-surface, and sinks again upon contracting.

Some of the Radiolaria enter into an extraordinary partnership with tiny globe-shaped organisms belonging to the group Mastigophora, scattered throughout its foamy body. These are yellow in color, due to chlorophyll, which enables them to form their food in the presence of sunlight from carbon dioxide excreted by their animal-feeding partner. In this process, they

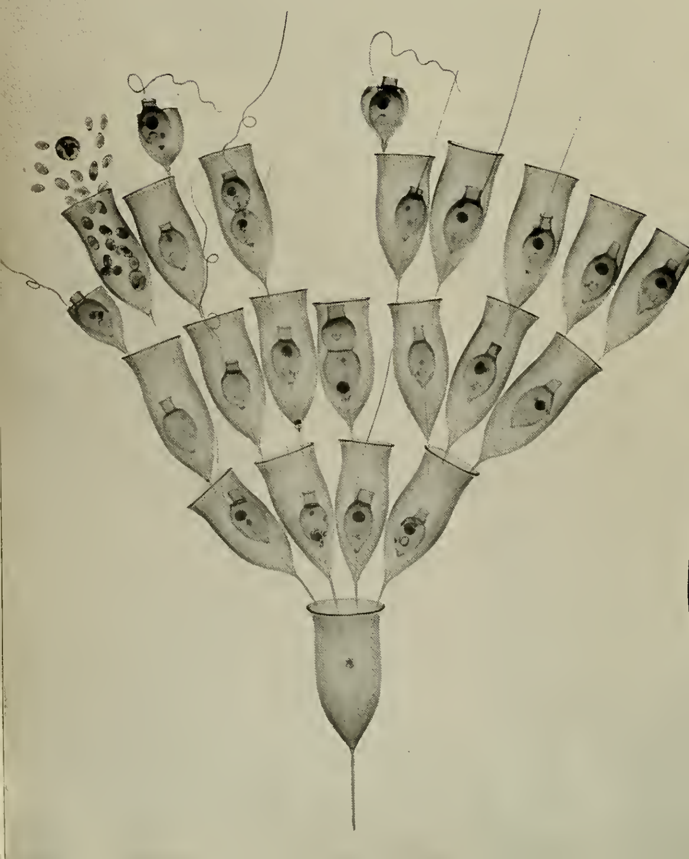
▼ THE GOBLET-CELL *(Monosiga gracilis)*: one of the Whip-bearing Protozoa, or Mastigophora. Its long, slender whip is here surrounded by a thin goblet-shaped membrane. The threadlike stalk anchors the creature to the pond bottom release oxygen which, in turn, is needed by the radiolarian.

The Ciliata are found both in fresh and salt water. Unlike the Rhizopoda, they have a definite body form and the outside is covered with close-set ranks of cilia or small hairlike structures, vibrating in unison, like tiny oars, to drive the creature through the water. In the various species, there is a great variety of shape as shown by the ciliate models in the alcove. One species (*Paramecium caudatum*), familiar to students, is streamlined like a submarine boat and has an equipment of multitudinous moving hairs arranged spirally, so that the animal rotates as it swims. Larger cilia, fused together in groups, line a shallow but gradually deepening trough (cytostome), the cell's equivalent for a mouth, and create a current in the water, which drives smaller protozoans, diatoms, and food-particles generally down through a tubelike "gullet," at the internal end of which a bubble forms to receive it. This "food vacuole," by means of fluid ferments, digests the prey while moving along the streaming currents of the internal protoplasm. Ciliata also have two nuclei, a larger and a smaller one. In many cases, highly specialized structures within the cell (organelles) perform special functions foreshadowing the many-celled organs of higher animals. In fact, some species of this group are considered to be the most highly organized of the Protozoa.

The Mastigophora start off with species of simple organization having changeable amoeboid bodies like those of the Rhizopoda, but, nevertheless, furnished with a whiplike flagellum for propulsion. Most species, however, possess a definite body form without cilia like those of the Ciliata, but with one, two, or several long flagella which propel them through the water.

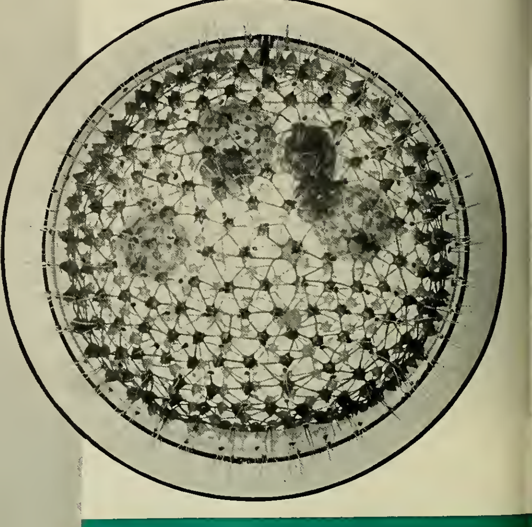
Some have a cytostome ("mouth") at the base of the flagellum, through which small organisms are taken into the interior. Others have no mouth, but, within the body, there are green, brown, or yellow structures equipped with chlorophyll, thus enabling them to obtain their food, like plants, in the presence of sunlight. This difference in feeding, which, in higher plants and animals, is so clear a distinction between the two great kingdoms, is here a matter of variation in related groups. So that, in this group of one-celled organisms, one may look for the first divergence between the Animal and Plant Kingdoms.

Some of the Mastigophora (Choanoflagellata), possess a delicate, transparent, collar-like structure around the base of the flagellum, which aids in food capture. Such species are often anchored to some object by means of a slender stem and so are stationary. In others, these stems are united to each other so that the individuals form a



◀ THE PROGENITOR INDIVIDUAL of this colonial "family tree" *(Stylobryon petiolatum)* has died, leaving its goblet-shaped house behind. Its four children have anchored their homes on the rim of the parental edifice and may be seen as tiny "collared animalcules" through the transparent walls of their dwellings. To the rims of these, in turn, are attached their offspring of the second generation, which have budded from their own parents, in the manner seen in the "house" of one of their own companions. A fourth generation has been added, and a fifth has started. The animal at upper left has suddenly divided into multitudes of spores

▼ *Volvox globator*: a remarkable colony of 1200 or more members, described in the text



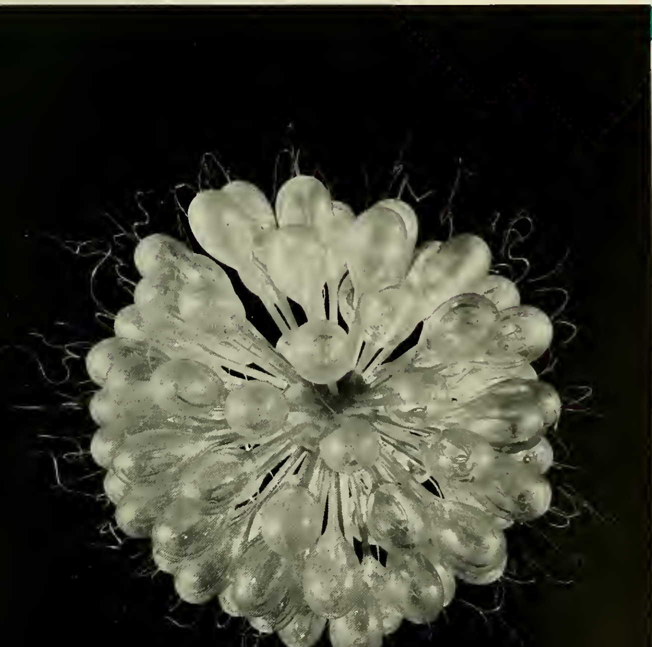
group or colony, which may be either fanlike or united in a spherical cluster of many similar individuals. In the case of the species *Volvox,* there are a thousand or more individuals united to each other by a network of protoplasmic strands around a hollow sphere, each member of the colony possessing two flagella, by the combined motion of which, the colony rotates through the water.

It would be hard to say, at first glance, whether *Volvox* is a colony of single-celled organisms or a single many-celled organism, were it not that the various individuals are capable of existing independently at certain times, while, in many-celled organisms, the cells are dependent upon each other for their existence, being fundamentally specialized structures. Strange to say, there is a foreshadowing of specialization even in *Volvox.* For certain members of the colony become larger than the rest and sink into the interior of the spherical colony, dividing rapidly as they do so, until they form new miniature colonies like that of the parent. Eventually these break through the parent wall and swim away independently. These organisms, therefore, illustrate a method by which many-celled animals and plants may have been evolved from the Protozoa.

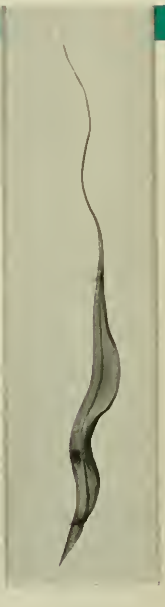
Among the Mastigophora are certain tapering organisms, swimming about by means of an erect "undulating membrane," which inhabit the blood of higher animals and man. These are known as *trypanosomes.* Some of them are apparently harmless, but others devour the blood cells and tissues, causing such diseases as African sleeping sickness. Another flagellate is responsible for the disease known as kala azar. Both of these are fatal to man, while related forms cause great depredations among cattle and other mammals. Protozoans of these groups pass part of their lives in insects and are transmitted to the higher animals by biting or, in some cases, by their excrement.

The group Sporozoa contains greatly simplified protozoans, structurally, reproducing by means of spores. They are usually characterized by complicated life histories. Among them are the dreaded organisms that cause malaria and yellow fever, which take an enormous annual toll of human lives. These last diseases are transmitted only by the bite of certain species of mosquitoes, within whose bodies a part of the sporozoans' life history is passed.

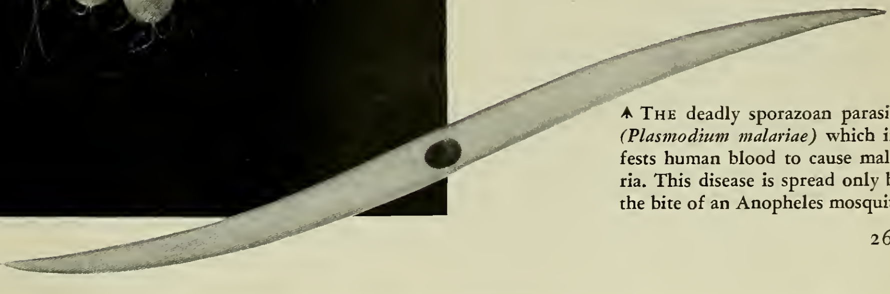
These are but a few instances of the protozoan organisms that must be reckoned with. Though they are so minute as to be invisible to the naked eye, because of that very factor, they are all the more dangerous. Mere size is an unimportant matter where vitality is concerned.



◀ A PROTOZOAN COLONY with individuals joining in a spherical cluster: *Synura uvella.* It is sometimes abundant in fresh water reservoirs in early spring. It secretes an essential oil having a fishy flavor, which, though harmless, alarms people when they taste it in their drinking water at such times



▶ THIS VIRULENT SPECIES *(Trypanosoma gambiense),* during part of its life is parasitic in the human blood, causing the fatal disease known as African sleeping sickness. It is transmitted from one human being to another through the bite of the tsetse fly, within the body of which it passes part of its life history



▲ THE deadly sporazoan parasite *(Plasmodium malariae)* which infests human blood to cause malaria. This disease is spread only by the bite of an Anopheles mosquito

◄ FUEGO, the volcano behind Antigua which poured forth lava during the disaster of 1773. Panic raged in the streets of the stricken city, as penitents confessed their sins publicly and thieves hastened to return stolen property. But despite all that the inhabitants suffered, many refused to leave the dangerous spot

► RUINS of the Monastery of San Francisco, largest and richest of the many splendid religious buildings that graced Guatemala's ancient capital

ANTIGUA

treasure house of the past

A catastrophic earthquake which wrecked the city could not destroy the spirit of Spain's New World capital, which survives today as one of the most remarkable relics of a colorful era

By DOROTHY REYNOLDS

All photos by the author

FEW people outside of Guatemala itself have ever heard of Antigua, for it is now only a small town—though one of the most delightful in the world. Set in a charming semi-tropical highland valley, it is surrounded by cool green coffee *fincas* and high purple-blue volcanoes. But two or three centuries ago it was a city gorgeous with the pageantry of church and state, the wealthiest and most splendid between Mexico and Peru, for it was the capital of the Kingdom of Guatemala, which included all of Central America, as well as a large section of southern Mexico.

Not many places in America contain so many reminders of the past as does Antigua, a past that is so integrally a part of the present that you can scarcely draw a line between the two. The town is as packed with treasures as a museum, and yet it has—as no museum and few ruined cities ever do—the charm of the casual mingled with the delight of the unexpected. Poor people live in ancient palaces, markets are held in old convents, tall rows of corn grow in some of the deserted monasteries, and cows and goats graze in the patios of others.

People meet you and casually invite you to "Come see our ruin!" Then, after a breathless half-hour of scrambling through fences and over ditches, of being stung around the ankles by mosquitoes, and having your hands and arms pricked by the sharp nettle-spines of the chichicaste and blistered by the milk-white juice of the *yerba mala,* "the wicked herb," you come upon the remains of some ancient church or convent. Its roof is fallen in and the statues and paintings gone—carted away to that newer and less splendid capital across the mountains, La Nueva Guatemala de la Asunción (now known simply as Guatemala City), which was founded after the earlier city had been shaken into ruins by a terrifying series of earthquakes.

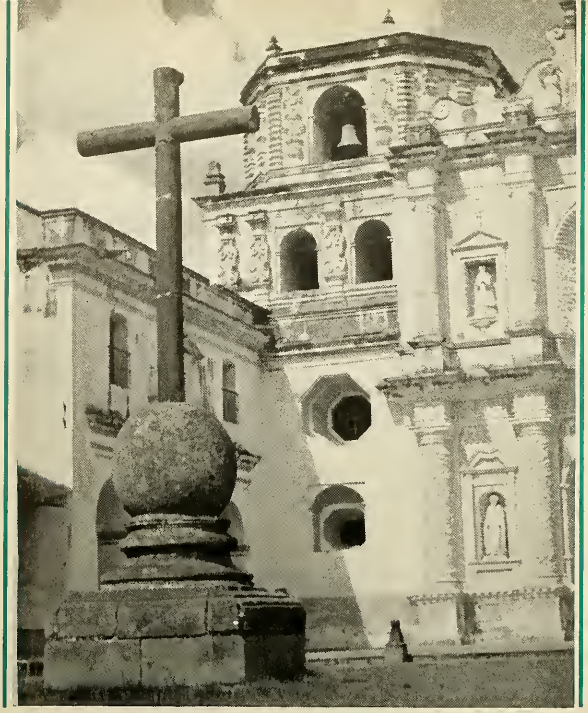
A city of churches

In Antigua, the remains of old churches can be seen in every block, and they are likewise scattered all through the surrounding *fincas.* Above the cornstalks and coffee bushes rise their creamy white walls, speckled with the shadows of tall *gravilea* trees and enriched by scrolls and fluted columns. Graceful shell-shaped patterns decorate the doorways, and a Virgin or a black Hapsburg eagle may be seen in a niche. Reminiscent of a long-past tragedy, these churches contrast with the lush green peace of the semi-tropics and bring sharply to one's mind grim tales of sudden destruction. Every road leads to a ruin, as does every path and trail. Hunting them out, one by one, you gradually begin to realize how very large the city must have been in the time of its glory. Once it is said to have had 60,000 inhabitants, but today it contains barely a fifth of that number.

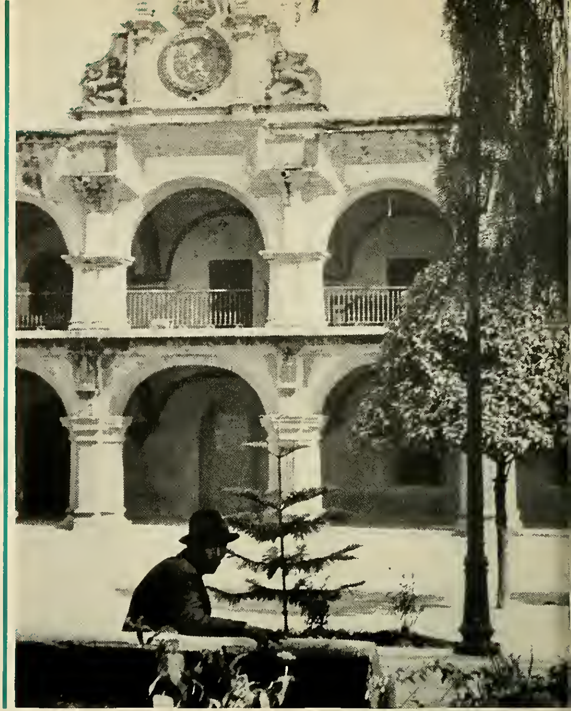
"Why did you come when I told you not to," I asked the boy guide who, uninvited, had taken me ruin-hunting, spending a whole sunny afternoon helping me through hedges and guiding me in and out of cornfields and coffee *fincas.* At first I had tried to get rid of him by every means I could think of, but long before the trip was over, I was extremely grateful I had him along to show me where to go.

He pushed his dilapidated hat back on his head till it hung by a single hair, and a charming grin flashed across his glistening brown face. "Because I knew you never would be

ANTIGUA



▲ THE STURDY CROSS in front of the Church of La Merced was one of three that were cast into volcanoes overlooking Antigua to appease the demons inhabiting them. Two were accepted, but this one was hurled back. This church alone survived the earthquake essentially uninjured



▲ THE still stately Palace of the Captains General, facing the flowers and fountains of a delightful plaza. Here in ancient times, nobles looked down while masked Indians danced on *fiesta* days and tournaments were staged by young blue bloods mounted on spirited chargers

able to find them for yourself," he admitted candidly.

In the days when all those buildings were new, the Muy Noble y Muy Leal Ciudad de Santiago de los Caballeros de Goathemala, as it was officially called, was an extremely wealthy and busy city, as well as a very grand one. From sailing vessels at the coast, an unending series of mule trains carried up all the luxuries of the East and the West. Fine Spanish laces and richly woven Chinese brocades and embroidered silks were imported to be fashioned into gowns for the ladies. Gold and silver were brought from the mines of Mexico and Peru, emeralds from Columbia, and coral and pearls from the coast of the Pacific to be made into jewelry.

Homes were furnished with elaborately carved chairs, tables, and cabinets inlaid with mother-of-pearl and silver. On the walls hung tapestries from the best looms of Europe and the Orient and rich paintings made by the great artists of Spain or by Indians under the direction of the friars. Rare pottery from far-off China stood on the tables, and upon the tile or brick floors were spread soft thick rugs from Persia, Syria, and Arabia. Family chapels were as magnificently ornamented, on a smaller scale, as were the public churches, with gold altar-ware, rare paintings and sculpture, hanging lamps of solid silver, and crystal chandeliers. In the workshops of the city, goldsmiths, silversmiths, sculptors, painters, and wood carvers—some of them immigrants from Spain, but most of them trained Indians—worked day and night to carry out the ambitious projects of the proud Guatemalan nobles.

The Capital was full of wealthy merchants, and the whole surrounding valley was occupied by vast *estancias*. On these, as in our own California in its Spanish-colonial days, great herds of cattle were raised mainly for their hides, which were shipped to Spain. Consequently, meat was so cheap that the poorest family could buy a week's supply for only a few cents.

In those days, Antigua must have been like a very great lady—beautiful, proud, and gracious, but a little aloof on account of her own realization of the importance of her position. Now, she resembles a high-born dame who, having suddenly lost her fortune, has settled into the routine of a cheerful middle-class housewife, without any useless regrets for the past but with an unconscious dignity that still gives a hint of the exalted position she once occupied.

The Antigua of today is full of a leisurely, friendly charm. It is a town rich in legends and a good place to relax and dream. It is so quiet there that all sorts of pleasant sounds can be heard, day and night, sounds which in other places are beaten into silence by harsher noises—the singing of birds in the coffee bushes, water splashing, boys whistling down the road, and everywhere the soft, slow ringing of church bells. Those bells were one of the omnipresent sounds in the life of the old city. At brief intervals throughout the day, they pealed forth, one after another in definite succession, first calling the people to morning Mass, then reminding them that it was the hour of the Angelus, and in the evening announcing the last prayers of the day. One street is still known as the Street of the Bells.

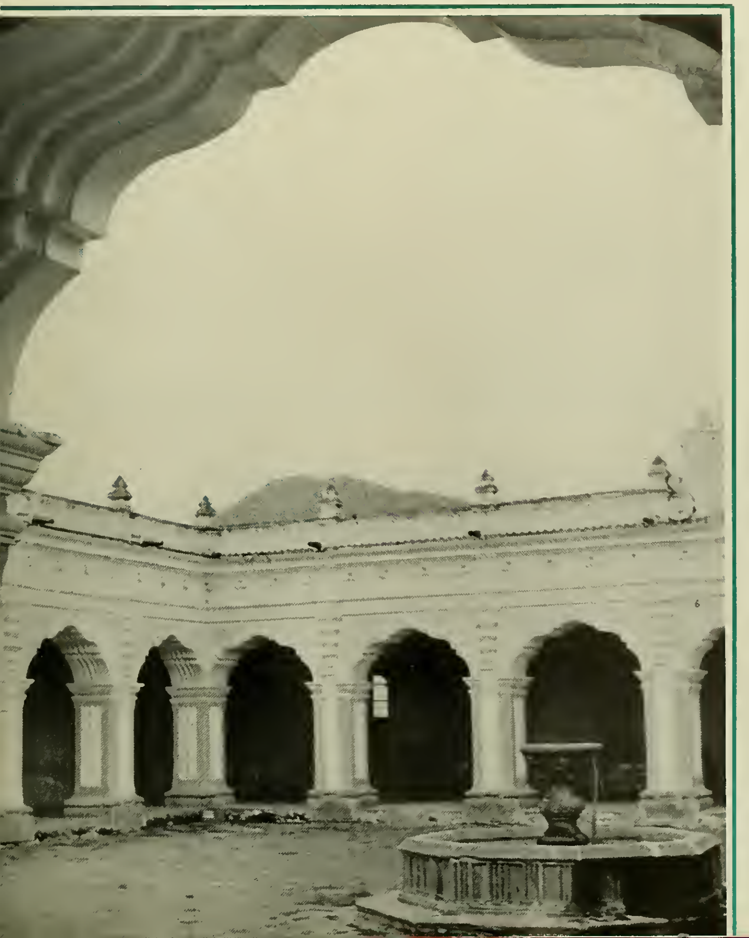
Today one hears the frequent tinkle of bicycle bells, which seem like echoes of the campanilla that Hermano Pedro, Antigua's own special holy man, used to keep ringing constantly as he went through the streets urging sinners to repent. But these little bells have none of the harsher tones of the original; like pleasant daytime ghosts out of the past, they suggest only the gentle sadness which should go with all repentance, even that of three centuries ago. And at night one's ears are filled with the pervasive croaking of frogs and the whir of crickets, while big stars shine above the trees.

In Antigua, you can stay at a pension on a coffee plantation, where acres of glossy-leaved shrubs drip with compact clusters of coffee cherries that turn slowly, one by one, from green to red as the season advances. Behind the pension is a sunny patio filled with flowers—tree-tulips, Italian carnations, and tall white hollyhocks, known here by the stately name of Saint Joseph's staff. Yet this plantation is only four blocks from the main public square, today as always the center of the city's life.

This plaza is a delightful park, filled with flowers and tinkling fountains, and surrounded by picturesque arcades. On one side stands the still stately Palace of the Captains General, while the crumbling Cathedral rises on the other.

In Colonial times, the whipping post for recalcitrant Indians and the gallows upon which criminals were put to death were set up in the plaza. Indians staged sham battles and performed dances there on *fiesta* days, while the Spaniards watched and applauded from the windows of surrounding buildings. Members of the nobility were given places of honor on the balcony of the Palace, which was gorgeously decorated with a crimson canopy and hung with colorful banners of Spain and Guatemala and the coat of arms of the capital city (three smoking volcanoes with Santiago on horseback soaring triumphantly above them). There were tournaments, too in which young nobles took part—gorgeous spectacles straight out of the Middle Ages. Banner decorated tents for the participants were placed round the plaza. One by one, the *caballeros* came out, dressed in suits of bright-colored satin trimmed with gold and silver, their sleeves edged with rare laces and their shoulders covered with capes adorned with gay plumes. Each knight, attended by several lackeys in livery, was mounted upon a spirited horse, whose trappings likewise were rich with gold-fringed velvet and sparkling jewels. During the jousting, music was provided by drums, trumpets, clarinets, and marimbas, and in the evening elaborate fireworks were set off.

▼ **THE EARLIEST** center of higher learning in Central America, founded in 1676: the University of San Carlos in Antigua, now a museum



Ancient costumes used today

Such an impression did the costumes of the nobles make upon the Indians —who must have formed an enthralled, though scarcely noticed, part of the audience—that to this day they copy them in their own favorite dance-drama, *El Baile de la Conquista* (The Dance of the Conquest). The yellow velvet of their short-jacketed suits is made gorgeous with much gold and silver braid, but the sparkling jewels of the Spanish *caballeros* are replaced by tufts of feathers, strings of vari-colored beads, and small round mirrors to catch the glint of the sun.

In the plaza on *fiesta* days, richly dressed lords and ladies mingled with church officials and members of the religious orders in their varied ecclesiastical robes, with Indians in brightly colored regional costumes, soldiers in military uniform, and university professors wearing the colored hoods denoting their specialties. The University of San Carlos is still standing a few blocks away. It is a low, rambling structure with many arches and a graceful fountain in the central patio. Founded in 1676, it was the third-oldest institution of higher learning in America and enjoyed the same rights and privileges as the famous University of Salamanca in Spain. Now the building serves as a museum.

Today, small-boy bootblacks hover continually around the stone seats of the plaza and only the barefoot Indians can walk past unmolested. "Goo' by! Goo' by!" the little fellows greet you cheerfully. "Fi' cent'! Shine!" They are very proud of their command of English and eager to enlarge their vocabulary. Trickily, they offer to polish your shoes for five cents, and then, when you are comfortably seated, casually explain that they meant five cents for each shoe!

Yet even the smallest and most ragged of them can be gallant when the occasion arises, though sometimes their courtesy assumes strange forms. "You are very fat!" one told me. I pretended not to hear, reminding myself that the little fellow did not realize his own impoliteness, but a moment later he repeated the remark. "You are very fat—and very beautiful!" Only then did I realize that he intended to offer me a compliment. In many subtle ways, the standards of Guatemala are different from our own.

To the north of the plaza stands the Cathedral, once the most important religious edifice in the whole kingdom. Only one chapel is still in condition to serve as a church, and four of the five naves are unroofed, though the fluted pillars and ruined arches that remain are breath-taking in their grandeur. The rest of the enormous building — begun in 1543 and worked upon during the next 200 years—was largely destroyed during the earthquake. Even the sepulchre of the Conquerer Alvarado was so completely covered with debris that it has never been found. The church originally had seven entrance doors and was rich with innumerable paintings, much wood carving covered with gold leaf, and splendid marble statues of the Virgin and Apostles.

Religious pageantry

Through its portals passed many gorgeous processions. Most impressive of all—according to Father Ximénez, whose description dates from 1721—was that which took place on Holy Friday. Then the officials and social leaders of the city, the priests in their richest vestments, many religious orders, all in their distinctive habits, and the members of the various guilds followed behind the statue of the Cristo Yacente. So numerous were the marchers and the statues of the saints, so solemn the procession, and so severe the dress of the women that, he declares, "It was one of the most devout spectacles offered to humanity."

Ancient Guatemala, like most of the Spanish colonies in America, had practically no middle-class, except for a limited number of skilled artisans. Nearly all the colonists who came over from Spain joined the ranks of the aristocracy. Scarcely less proud than the nobles, in spite of their formal vows of humility, were the incredibly numerous members of religious orders. In the Capital alone, there were 80 churches, most of which possessed adjoining monasteries. There were a few negro slaves, but the lower class was made up almost entirely of humble Indians, who did nearly all the work of the new colony, though they obtained very little of its wealth in return.

The various religious groups were granted vast tracts of land, known as *repartimientos,* and from the produce of these estates—wheat, cattle, sheep, and sugar cane—the monks piled up fantastic wealth and became highly influential. Bitter rivalry caused each order to try to surpass the others in the magnificence of its churches and cloisters, and sometimes quarrels broke out so openly that they had to be quelled by the civil authorities. The convents and monasteries, most of which had originally been thatched adobe buildings, became huge and ornate stone edifices that served as treasure houses for the riches within. Only the daughters of wealthy nobles could afford to enter the convents, for the novices had to bring with them "portions" which usually amounted to between 500 and 1000 gold ducats. Though they were put under strict vows of poverty, each of these girls had one or more serving maids, as well as all sorts of rich and luxurious furnishings to lessen the severity of their cells.

Most notable of all was Doña Juana de Maldonado. Her father, a powerful noble, proud of the beauty and accomplishments of his daughter, who was a talented poet and musician, heaped gifts upon her—pictures, silver lamps, jewel-bedecked statues, and cabinets faced with gold and silver. He even had a special quarter built for her, with rooms and galleries, a private walk, an individual chapel with rich hangings and pictures, gold candlesticks, and a small organ. For attendants, she had half a dozen blackamoor maids. But when the proud noble attempted to have his 20-year-old daughter appointed abbess, it split the city into such bitter factions that civil war threatened, and all the bells were set clamoring at once as a signal of disaster.

In Gage's time, the monastery of the Dominicans, which housed about 100 friars, was one of the richest of all. It included a magnificent church filled with immense columns, gilded arabesques, and cloisters. One of its gardens contained an artificial pool a quarter of a mile long, with paved bottom, where the friars could go boating and fishing for recreation. In the chapel was a life-sized statue of the Virgin made of pure silver, and before the altar hung a silver lamp so large that it required the united efforts of three men to raise it into place.

A lively market

In the neighborhood of this monastery in early times were situated the most exclusive shops and the finest houses. Here, also, was held the daily open-air market, where Indians from neighboring villages sold fruit, herbs, and cacao. The townspeople congregated here to buy Indian dainties, such as *atole* (a sort of corn-meal mush), scalded plantains, cocoa, and puddings made of maize wrapped in banana leaves and containing a bit of fowl or fresh pork well seasoned with biting red chili. The latter were called *anacatemales,* and were doubtless like the small hot tamales, slangily known as "little dogs," which are still a specialty of the region.

After the earthquake, the market left the plaza and moved inside the half-ruined, roofless Jesuit monastery, where it is still held. In the early morning, Indians from the neighboring villages come there with bundles and baskets of fruits and vegetables, flocks of chickens and turkeys, and carrying-crates piled high with pottery jars and dishes.

The cloister of the Capuchins is now occupied by weavers. All day long, in hallways and patios once filled with half-whispered prayers and with the soft swish of robes, men stand today at their primitive foot-looms, flashing the shuttles back and forth with skillful patience, filling in the bright patterns of red, blue, and yellow which border the white cotton fabrics so highly prized by both tourists and Guatemalan housewives.

The "Guatemala City" mentioned so often in old chronicles and diaries is this original settlement, not the shining modern one across the mountains. The latter sprang up after the earthquake caused abandonment of the original capital and left it to be called Antigua, The Ancient One. That was an earthquake which shook the city empty both of its population and its accumulated treasures. The fleeing people carried across the hills even marble statues, ornate carved doorways, stone fountains, and, in some cases, whole houses, which they tore down and transported piecemeal, to be set up again on the other side.

The disaster

From the time of its foundation in 1541, the city had been periodically troubled by earthquakes, but in 1773 a continuous series began which gradually grew worse and worse, until at times men and women had to crawl through the streets on all fours. For days, tiles and stones kept hurtling through the air, and by the time the shocks stopped scarcely a building of importance remained uninjured.

Mass-panic took possession of the people. A monk, seeing the statue of the Virgen de la Luz dancing in its niche, ran crazed through the streets until he fell dead. Priests prayed ceaselessly, and processions of penitents went through the town, lashing themselves and moaning piteously. The days were dark with dust and the nights bright with the streams of flaming lava that flowed down the sides of the nearby Volcán de Fuego. The townspeople, sure that the Last Judgment was close at hand, waited in long queues to tell their sins to the priests, or, despairing of reaching them in time, confessed to one another and ran through the streets crying their derelictions aloud. Enemies begged and granted mutual forgiveness, thieves returned stolen property, and Spaniards who had been shamefully abusing the Indians for years kissed them and publicly begged their pardon.

In spite of everything the inhabitants of the doomed city had endured, when the King of Spain finally ordered the Capital moved across the mountains in 1775, many people did not wish to go, and the officials had to pass all sorts of curious laws to bring about abandonment of the *pueblo*. One prohibited the making of any repairs on the houses. A man could not so much as mend the roof of his own dwelling place to keep out the rain. At last, most of the families left, but a number of the poorer ones remained, making themselves comfortable in the least ruined parts of the buildings abandoned by their owners, even in some cases, in the palaces of nobles and high officials. Strangely enough, Antigua has never since suffered a heavy earthquake, though the newer Guatemala City has had several, one of which shook down a large part of it in 1917.

The Church of La Merced was the only important building of Antigua that passed through the earthquake essentially uninjured. It is still beautiful, with its pale grey façade covered with white arabesques forming graceful frames about the statues in their niches and twining around the pillars like delicate frostwork vines. The sturdy stone cross which stands in front of it bears a curious history.

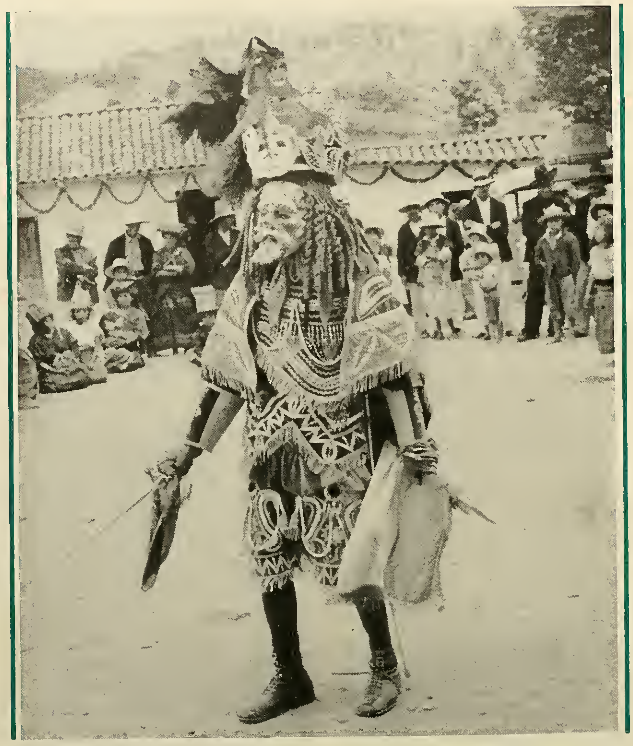
Early colonists from Spain were much frightened by the numerous active volcanoes in the new country and believed them to be the abodes of ancient pagan demons. So they conceived the idea of baptizing the unholy peaks by casting crosses into their craters. Of the three volcanoes that overlook Antigua, two of them, Augua and Acatenango, submitted peacefully to the ceremony, but the third, Fuego, instead of accepting its cross, flung it back into the very faces of the officiating priests, who thereupon had it brought down to the valley again and set up in front of the Church of La Merced.

Far larger than the Cathedral was the Monastery of San Francisco, now little more than a pile of ruins in one corner of the town. The pillars and arches, however, are still impressive, even in their decay. One may wander for hours among a maze of roofless rooms, crypts, naves, arches, and grassy patios. From the old bell-tower you may scramble out onto an open earth-covered section where grass and wild flowers have taken root—a place from which there is a marvelous view of the whole town, as well as of the surrounding mountains. Only one part of the church is still intact, the small chapel of the Third Order. It is there that pilgrims go to find the tomb of Hermano Pedro, and to waken him with three blows of their knuckles (never more and never less), rapping sharply so as to be certain he will hear, before uttering their petitions, for he has been dead now for many years.

Origin of a hospital

Pedro de Betancourt was one of the most unforgettable of the many strange characters in the ancient city. Born in the Canary Islands, he embarked for the New World as a young man, his heart burning with desire to become a Franciscan monk. But there was one insuperable difficulty. Try as he might, studying all day long and far into the night, not a word of Latin could he learn, not a single one of the long liturgies. Finally, however, he was admitted to the Third Order, a sort of auxiliary group, and became inspired to help the sick. He bought a straw-thatched hut in the suburbs and often transported the leprous and plague-stricken to it on his own back. Other monks joined him, and the

▼ DANCE OF THE CONQUEST. The *fiesta* costumes of the young nobles in Colonial days so impressed the Indians that they copy them today for their favorite dance. This depicts the defeat of their ancestors by the Spaniards. Here Tecum Umán, valiant Indian leader, is reciting his death speech



pious donated money for a better building. Today the hospital he founded is still used by the people of Antigua.

Brother Pedro felt himself called upon to save sick souls as well as sick bodies, and nightly he used to walk up and down the streets, ringing his little bell and chanting:

"Hermanos, hermanos!
Peregrinos somos, y por el mundo vamos!
Una alma tenemos, y si la perdemos,
No la recobramos!"

("Brothers, brothers! Pilgrims we are, and through the world we go! One soul we have, and if we lose it, we cannot regain it!")

Hermano Pedro is said to have performed many miracles and is now being considered for canonization. All about his shrine hang little wax votive offerings—tiny figures of men and women, arms and legs, hearts and eyes—placed there in gratitude by sufferers who believe themselves to have been healed through his intercession. In the rear of the chapel stands an Indian-colored Christ with long brown curls of real hair and a crimson robe—a tired, sorrowful figure, bent low beneath a heavy cross, curiously decorated with silver grape leaves. Even in Antigua, which is one of the least Indian cities of Guatemala, the aboriginal keeps breaking through in just such unexpected places.

The little boys who guided me to the ruined convent of Santa Rosa were certain that the statue of a woman with a child in her arms must be the Saint herself. I insisted that it was rather the Virgin Mary, but they remained unconvinced. "Santa Rosa was also a Virgin," one of them explained in the patiently polite tone reserved the world over for ignorant and presumptuous newcomers. "And here all the Virgins have children."

"Yes," echoed the other. "They all have *niños*—the Virgin of Remedies, the Virgin of Health, the Virgin of Solitude—oh, there are many Virgins, and every one has her baby!"

A large number of the old Colonial houses are still standing, their white, cream-colored, or pale pink fronts pushed tight against the narrow sidewalks. Their overhanging eaves are covered with leaf-brown or dull red tiles, their windows guarded by iron or turned-wood *rejas*. The studded doors, hanging upon great ornamental hinges, are furnished with wrought-iron knockers, generally in the form of a disembodied hand that seems to reach forth in ghostly fashion out of the past. Some of these buildings are in a ruined condition, but in recent years a number of them have been repaired by well-to-do families.

Best-known of all is the Popenoe House, the property of an American who has lived for many years in Guatemala. Much time and effort have been spent in restoring this old *casa* and furnishing it with antique chairs and tables of the style it originally contained, carved wooden plaques and statuettes. There is even an old-fashioned raised fireplace for the kitchen, where dozens of pots and pans hang upon the walls, and an Indian cook takes charge of the preparation of the meals.

Romantic tradition connects this house with the Casa de Los Leones not far away, a building with a curious stone lion on each side of its huge studded doorway. In it lived Don Alvaro de las Asturias who was in love with Doña Beatriz, whose home was what is now the Popenoe House; but her father, Don Teófilo de Alvarenza, disapproved of the match because the young suitor was the son of a merchant. One morning, the body of Don Alvaro was found behind the church of San Francisco, stabbed through the heart. The murderer could not be discovered, but immediately afterward Hermano Pedro began to walk by the home of Don Teófilo very often, tinkling his little bell and chanting his song. This lasted for several weeks, until finally Don Teófilo came out one night, unable to endure it any longer, and admitted that he himself had hired a half-breed to kill Don Alvaro. Next day, he made a formal confession of the crime before the *audiencia,* the royal court. He was sentenced to death on the gallows and hanged in the courtyard of the Palace of the Captains General. A few days later, Doña Beatriz entered the Convent of Santa Clara as a nun.

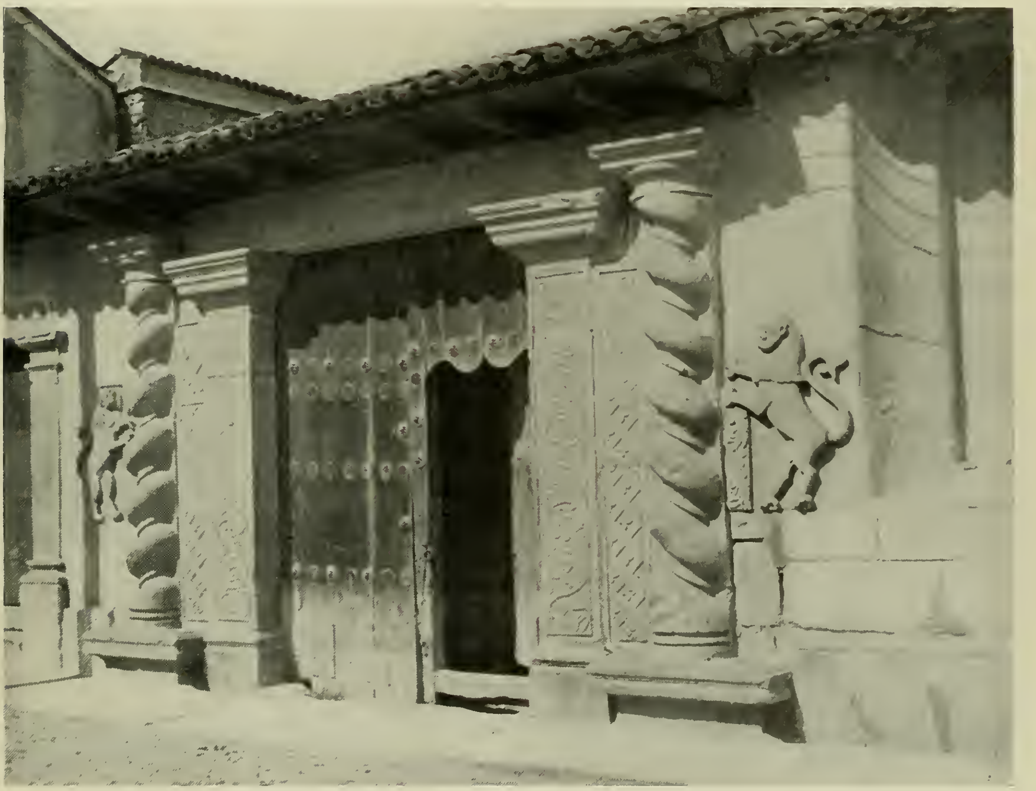
According to common belief, a

$100,000 treasure was hidden somewhere about the premises of the Casa de Rodil, built in 1650 by a Spanish grandee. A former renter found a portion of it, and now the lease states that if the present occupants discover any more, the owners are entitled to a definite part. Another fortune was dug up beneath the "courting seat" of the house across the street. In olden days, most families kept their wealth secreted in such places about their homes, and some of them evidently abandoned their hoards when they left hurriedly during the earthquake. There are also countless legends of other treasures hidden in the mountains by the Indians at the time of the Conquest to prevent their falling into the hands of the Spaniards.

Evening is always a pleasant, tranquil time in Antigua, but Sunday evening is the best of all, for then, even more than on other days, the inhabitants of the town come out of doors and walk slowly about, enjoying the beauty of the sunset and the coolness of the dusk. Gradually the rose and blue of the houses deepen and grow richer; the thick, overhanging eaves throw darker and darker shadows. Windows are flung open; and people sit on the wide sills and on the doorsteps, chatting, singing, and laughing. As the faint sound of a guitar drifts through the darkness, one wonders if the town is essentially very different now from what it was in Colonial days. It is smaller, of course, and less wealthy, and yet it must be even richer in human interest from having lived and enjoyed life so long. The *ladinos* are there still, and the Indians hover in the background as they always have, ever-present, yet never obtrusive. Only the high-born knights and ladies of the olden days are lacking, and their shadows seem to be very near.

The Popenoe House looks a little lonely, with its shutters and doors closed tightly and with no friendly or curious faces peeping out. It seems almost too perfect, with its freshly painted white walls trimmed with rose, its mottled brown tiles and hand-turned wooden *reja* bars—a bit too untouched by life, like one of those saints in Guatemalan churches that have been kept in glass cases and worshipped from a respectful distance. The other houses remind one of those favorite statues that have been prayed to and kissed and wept over, smoked with incense, carried frequently in processions through rough, dusty streets. Yet this house, too, only a few years ago, was but a mass of crumbling ruins, tumbled down by the raging gods of the volcano on that day when the earth trembled and proud men and women, as frightened as naughty children, ran through the streets, confessing their sins aloud, so that all might hear.

∨ "THE HOUSE OF THE LIONS"—famous in romantic tradition as the residence of Don Alvaro de las Asturias. Don Alvaro was in love with a belle of Antigua, but her father, opposing the marriage, finally had him slain. He was forced to confess by a famous holy man who incessantly rang a bell in the street. calling sinners to repent



HAND COLORING YOUR PICTURES

By CHARLES H. COLES

Chief Photographer,
American Museum of Natural History

COLOR plays such an important part in the world about us that its lack in an ordinary photograph is usually keenly felt. Of course we have learned to interpret black and white pictures as a reasonably accurate reproduction of natural objects, but their lack of color is, nevertheless, still an annoying departure from reality.

In photographing plants, animals, and minerals, color is especially desirable. It is for this reason that natural color photography has been used to a greater and greater extent in recent years. But direct color photography is not always feasible, and its limitations frequently prevent its use for recording natural phenomena. Intense contrast, extremely dim illumination, light of incorrect color quality—all make direct color photography out of the question much of the time.

The problem arises quite often when it is found that pictures made in black and white in the past cannot be retaken in color because the former conditions have ceased to exist or because it is not possible to revisit the locality. Still another point to be considered is that large prints from direct color pictures are expensive and not always satisfactory.

Photograph by Charles H. Coles

A STRONG PHOTOGRAPH of the type that can be effectively hand colored by the Flexichrome process. In this process, dyes replace the blacks and grays of a specially prepared positive image and can be changed or adjusted until the desired effect is achieved

A Controlled Color Process

A color process has been developed under the trade name of Crawford Flexichrome that will often bridge the gap between black and white photography and a color picture.

An enlargement of a black and white negative is made on a special film which is processed in a special way. The back of the film is coated with a white paste that hardens to a white backing to reflect light through the film.

The film is dyed in a black dye solution, whereupon the positive image of the original negative appears. The peculiar property of this black dye is that it may be replaced readily by colored dyes.

The picture is now colored by hand, using special dyes for the purpose. The colored dye actually replaces the black dye and even colors the shadows in the picture, giving the appearance of an actual color photograph if the work is carefully done.

The person who does the coloring must have a certain sense of color, of course, but it is surprising how good a carefully done picture will look. Nothing is permanent until the picture is considered finished. The colors may be changed or adjusted as much as desired. A new color applied to any part of the picture will replace the old color.

Photographs used in certain cigarette advertisements are colored in this way, thereby achieving a brilliance and purity of tone unobtainable by direct color photography.

On a recent occasion this color process made it possible to add an important picture in a Kodachrome series on the dinosaurs that was produced by the American Museum of Natural History. A series of pictures had been taken in color in the Museum and in the field, but a picture was needed that would show the digging up one of the largest specimens. Such a picture had been taken years ago on an expedition but was in black and white. The picture was enlarged and very carefully colored by the Flexichrome process and then photographed in Kodachrome. The result was all that could be desired, and the series completed effectively.

It must be emphasized that this process, if carefully done, will result in a picture exactly like a direct color photograph. No part of the picture need be gray or degraded in color due to an underlying photographic image. The colors may be as pure as desired. It is obvious that the more artistic ability one brings to this task, the finer will be the result, but even the veriest amateur will achieve surprisingly good results, since, as explained before, color values can be adjusted indefinitely until they appear satisfactory.

Hand coloring photographs is a very old method of bringing black and white pictures closer to the truth. The use of transparent water colors was the earliest method, but the newer transparent oils are by far the easier to manipulate.

The picture to be colored should be printed or enlarged on a matte surface paper, not on a glossy paper. A print predominating in lighter tones will be more effective than lower key pictures, because the oils can color lighter areas more brilliantly.

If the original photograph was taken with soft and flat lighting—that is, with the source of illumination behind the cameraman—the picture will be ideal for coloring because of the absence of dark shadows. This type of lighting is usually the best for direct color photography anyway, so, of course, it would naturally be preferred for coloring work, too. A recent display of hand colored pictures

Continued on page 275

YOUR NEW BOOKS

MONEY BIRD • VIOLETS • SULPHUR • AUSTRALIAN FRONTIER
ASTRONOMY • MAN • CAROLINA BAYS • NEGROES IN BRAZIL

TRAIL OF THE MONEY BIRD

- - - - - - - - by Dillon Ripley

Harper & Brothers, $3.50

THERE are few travelogues that have both charmed and captivated me like the present one. Ripley succeeds in that most difficult task of a writer, to bring back the atmosphere of the faraway places he has visited. His descriptions are so vivid and expressive that reading them was like being back again in New Guinea and the other places where our trails have crossed.

A naturalist who has been in the interior of New Guinea has enough interesting stories to tell without spoiling them by journalistic exaggeration, as many of the so-called "explorers" do. There are birds of paradise, displaying themselves on their special dancing places; there are bower birds and hornbills. There are curious forest rails that sleep in leaf nests, and there are those most peculiar animals, the giant echidnas. They look like a cross between an anteater and a porcupine, but lay eggs from which suckling young develop.

Even more intriguing than animals and plants are the natives. Ripley lived with the shy Arafuras of Misol Island, with the (ex)pirates of the Schildpad Islands, with the seafaring Biak Islanders and with the primitive woodsmen in the mountains of the Vogelkop. The latter still live in a Stone Age culture but are in many respects more lovable than the more civilized natives of the coastal districts—Suva, Tulagi, Rabaul, Java. These and other places that are now in the news were visited by Ripley and made to live for us in his tale. The word "New Guinea" of the news dispatches has an ugly ring. Those who want to become familiar with the real New Guinea, especially the Dutch part, should entrust themselves to Dillon Ripley. There is no more competent and sympathetic guide.

E. MAYR.

SPEAKING OF MAN

- - - - - - by Michael F. Guyer

Harper & Brothers, $3.50

IN this book a biologist speaks of man. For several years the American Museum has been urged to do something grand and striking in exhibits dealing with the Biology of Man. It is an intriguing idea that somehow the biology of man, if dramatically presented, would save the world by solving our social and economic ills. The tendency is to blame science for all that is wrong and yet to call upon scientists to set our house in order. This book presents a series of interesting chapters inspired by such challenges. The strongest chapters are "Science and its Critics," "The Rise of Intelligent Behavior," and "The Endocrine Control of the Body." The weakest is the chapter dealing with the shortcomings of education, the chief exhibit being a series of college examination boners. Democracy receives attention on eugenic grounds, and the familiar charge is made that the ideal of democracy is abused when it gives the unfit freedom to increase in relative numbers.

The last chapter considers the impact of science upon religion. The author recognizes the dilemma in that science destroys something vital but offers no substitute. His point of view may be inferred when he writes, "In most individuals there is apparently a subconscious impulse . . . to seek some form of religious guidance."

C .W.

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THE ORIGIN OF THE CAROLINA BAYS

- - - - - - - - by Douglas Johnson

Columbia University Press, $4.50

DR. DOUGLAS JOHNSON, Professor of Geology in Columbia University and a leading world geomorphologist, has during the past ten years spent much time in attempting to discover the origin of the so-called Carolina "bays." These formations occur on the coastal plain of North Carolina, South Carolina, and Georgia. Although the bays were known for many years, it was Professors Melton and Schriever who discovered their abundance and remarkable distribution. These shallow depressions with very low rims are hardly noticeable from the ground, but they show up in a striking manner in aerial photographs. By examining such photographs, Melton and Schriever discovered that there were hundreds of "bays" or "craters" of beautifully elliptical shape with their long axes almost parallel and extending in a northwest-southeast direction. It is now known that there are many thousands of them scattered over a 25,000 square mile area.

Melton and Schriever argued that these "bays" were the scars produced by a vast shower of meteorites. Many scientists accepted this theory, but Doctor Johnson has written a book which will raise strong doubts. He carefully studied the aerial photographs and personally examined 127 "bays" on the ground. In his introduction he says that in more than 40 years of geological study, he has encountered no problem so difficult.

The explanation advanced by Doctor Johnson to account for these bays, he modestly calls the hypothesis of complex origin. It seems that he would have been justified in dignifying it by the name theory. It is too complex to be discussed adequately in a brief review, involving as it does artesian spring action and solution; most of the depressions formerly if not now were occupied by lakes, whose waves smoothed the contours of the basins and often built beach ridges, the sand having been transported by wind action. It is a fascinating piece of scientific research carried out in an admirable manner.

CLYDE FISHER.

HANDBOOK OF FROGS AND TOADS

- - - - - - - - by Allen Wright and Albert Hazen Wright

Comstock Publishing Company, $3.00

THIS little volume contains descriptions, life history notes, photographs, and keys that will enable the amateur naturalist to identify and acquire familiarity with the frogs and toads of the United States. It is all that a handbook should be—indeed, much more. The beginning student will find it interesting and stimulating, and the professional herpetologist will turn to its pages frequently for a summary of present knowledge of these amphibians.

The book is the outcome of a lifetime of study and photography. The Wrights first published the results of their activities in 1933 in the first edition of their handbook. Numerous advances in herpetological work have necessitated this new edition, and the enthusiastic reception of the earlier edition proved its desirability.

The revision and consequent expansion have been fairly uniform throughout the book. The two outstanding features are the fine photographs, illustrating practically every form of frog and toad, and the excellent bibliographies at the end of the book. These have been largely expanded with useful recent additions. The index has been greatly improved through the inclusion of scientific names.

This reviewer finds few faults in the present volume, and these will be of little concern to the student. A number of herpetologists will not completely agree on the systematic arrangement of some forms, but this volume is sure to take its place above its predecessor as the outstanding book on the frogs and toads of the United States.

J. A. OLIVER.

OUTLINES OF ECONOMIC ZOOLOGY—Fourth Edition

- - - - - - - - by Albert M. Reese

The Blakiston Co., $3.25

THIS is a systematic review in outline of the entire animal kingdom, from the microscopic single-celled animals of various human diseases, to the giant whale which may yield "30 tons or more" of oil. Animal by animal, group by group, there is statement of the obvious values or harmfulness of each to mankind, with methods of its utilization or control.

It is a great convenience to have tangible data on so broad a subject accessible in one small volume, and familiarity with its pages will be an excellent introduction to economic zoology. One should realize, however, that in many cases space permits of only the briefest statements, and there is little attempt to discuss, follow, or visualize the often intricate problems of this science, or the balance of nature on which it so largely depends. We read that the starfish eats quantities of oysters, which is true, though hard to believe until one has learned (elsewhere) how it does it,—that the horseshoe crab is caught "by the ton" at Delaware Bay and there used as food for hogs and as fertilizer. That by eating starfish eggs the horseshoe crab is a natural, if sometimes inadequate check on the starfish is not mentioned. Perhaps the intricacies of economics are as little followed. That the price of whalebone (once of great commercial and now of very little value) "has fluctuated" and "in 1940 was about 17½ cents per pound,"—in what must be a very limited market, is misleading.

Nevertheless, we have here a very interesting book, and one equally useful for reference, as is attested by this being its fourth edition. An excellent index makes the large amount and variety of factual material accessible, and there is also an extensive bibliography. It is attractively and durably made, as such a book should be.

J. T. N.

ASTRONOMY, MAPS, AND WEATHER

- - - - - - - - - by C. C. Wylie

Harper & Brothers, $3.00

THE author, who is professor of Astronomy in the University of Iowa, has given us a book on a surprising combination of subjects, perhaps never before included in one book. The reason for combining astronomy and meteorology is explained in the preface, where we learn that the book was prepared at the request of the Army Air Corps Flying Training Command, Doctor Wylie being a member of a committee nominated by Doctor F. R. Moulton, Permanent Secretary of the American Association for the Advancement of Science.

The first part, consisting of six chapters, treats of the fundamental circles of the celestial sphere, telescopes, the earth, the seasons and the calendar, the constellations and navigation stars. Besides northern and southern circumpolar star charts, there are twelve excellent star charts for 40 degrees north latitude. It would have been helpful to have had the same number for 40 degrees south latitude, since the constellations appear and "behave" so differently south of the equator.

The second part, consisting of three chapters, treats of weather, clouds, and weather forecasting. Beautiful photographs of the various types of clouds and other atmospheric phenomena are shown.

The third part, also of three chapters, treats of maps and map-making, time, and celestial navigation, with numerous helpful illustrations.

The fourth part, consisting of eight chapters, which might be called a survey course in general astronomy is not a "required" part of the course, but was written for those pilots who may become interested in securing a more complete knowledge of the sun, moon, planets, stars, and galaxies.

Doctor Wylie has produced a very practical and most attractive book for the purpose. The abundant excellent illustrations are especially to be commended.

CLYDE FISHER.

THE STONE THAT BURNS

The Story of the American Sulphur Industry

- - - - - - - by William Haynes

Van Nostrand Company, $3.75

TO those who are more or less familiar with it, the story of the mining of sulphur by the ingenious Frasch process is still one of the most notable American industrial achievements. But to most people it was a finished story, once the process was conceived and found to work. We find, however, on reading this book, that there were many more obstacles to overcome and that Frasch's genius was truly a remarkable possession. Herman Frasch had already demonstrated his ability by inventions in the oil industry, before turning his attention to the baffling problem of the recovery of sulphur overlain by a hydrogen sulphide impregnated, water-filled layer of quicksand. When he suggested melting it in place and pumping it out of the porous rock, it seemed to many to be a fantastic idea. Even though it worked, the difficulties were not all so simply solved. There were many subsequent headaches in the sulphur business, and each of them required a little additional ingenuity and American inventiveness.

William Haynes has done a splendid job of assembling all the data of the industry's history, and his account is carefully and fully documented with many references. It is a story of today's sulphur companies and of men who are still alive, and it brings the industry right down to the present. There is doubtless far more detail than will interest many general readers, but those with a special interest in the chemical field will find it a fascinating tale throughout. The general reader will certainly find the first half, with its account of the pioneer work of the Union Sulphur Company and the trials of the Sicilian sulphur producers, well worth his attention.

F. H. POUGH.

THE IVORY-BILLED WOODPECKER

- - - - - - by James T. Tanner

National Audubon Society, $2.50

AMONG the North American birds fast nearing extinction, the strikingly handsome ivory-billed woodpecker is one that demands immediate attention if it is not to disappear completely from the living fauna. In order to learn as much as possible about the bird before it was too late, and to discover what means must be adopted to preserve its last survivors, Mr. Tanner was commissioned by the National Audubon Society to study it in its now restricted haunts and to explore its former range to learn what he could of the causes of its disappearance. The present report deals with the results of this survey, which occupied a total of about 21 months in the field.

Space does not permit a detailed summary of Mr. Tanner's findings. He discovered a probable maximum of 22 birds still living in 1939 in Florida and Louisiana, with the possibility of others in South Carolina. He ascribes the bird's disappearance from much of its former range to logging operations and the consequent absence of recently dead trees and their wood-boring-insect population on which the birds depend for food. He insists that any measures for the rehabilitation of the ivory-bill must depend on the preservation of an adequate area of suitable timber, either in a perfectly natural condition or subject only to selective logging in order to offer the primary feeding and nesting requirements of the species. Given the best possible conditions, with complete protection, the ivory-bill may yet be saved from extinction.

Details of appearance, behavior, food, distribution, population density, past and present ranges, and similar facts are each discussed in some detail, and the brochure is illustrated with a colored frontispiece, photographs, and line drawings. It is highly recommended to everyone interested in conservation and especially in the preservation of this largest and finest of the North American woodpeckers.

John T. Zimmer.

Wild violets of North America

- - - - - by Viola Brainerd Baird

University of California Press, $10.00

IT is most fitting that this book should be prepared by Viola Brainerd Baird, for she is the daughter of the late Ezra Brainerd, leading authority on the violets of North America. Her father is the author of *Violets of North America,* and it was he who revised the section on violets for the last edition of Gray's *Manual.*

Not only did Mrs. Baird draw heavily on the classic work of her father, but she has combined it with the results of subsequent research in this field. She gives us an up to date book, which by means of text, keys, and illustrations makes it possible for anyone, whether amateur or professional, to identify any species of violet known in the area considered.

In North America north of Mexico there are some 77 different species of wild violets. All of the full species except one, together with several subspecies, have been done in full-page color plates by the well-known artist and naturalist, the late F. Schuyler Mathews. These excellent drawings in color are supplemented by many helpful line drawings. The paintings in color and the line drawings were made in almost every case from fresh living specimens. And the description of each violet was made with the growing plant at hand.

The descriptions of the violets include both the flowering and the mature stages, for, as the author's father wrote, "Violets are much alike at flowering time, but only in late summer are marked specific characters developed. Then the mature leaves, the closed flowers, their peduncles, sepals, capsules, and ripe seeds all reveal striking differences. With this knowledge at hand, a child may be taught to distinguish the species."

Here is a beautiful book, both scientifically accurate and popularly written.

Clyde Fisher.

Geology in the museum

- - - - - - - - - by F. J. North
C. F. Davidson and W. E. Swinton

Oxford University Press,
for
The Museums Association, $1.50

THIS handbook is designed to furnish some details of geological museum technique for the assistance of curators in general and local museums. It is concerned with the preparation, preservation, cataloguing, and, to a lesser extent, the exhibition of geological, mineralogical, and paleontological specimens. A number of "recipes" and techniques employed in the museum are described and their problems and advantages outlined. It is this content which makes this work of great value to the average collector and student to whom it is sincerely recommended.

H. E. Vokes.

Australian frontier

- - - - - - - - by Ernestine Hill

Doubleday Doran & Co., $3.50

IN this timely book northwest and central Australia are described, a part of Australia which will be much better known after this war to many of our American soldiers than to most Australian city dwellers.

Starting off by plane but later using any available means of transportation, the author traveled northward along the

Continued on next page

★★★★★★★★★★★★★★★★★★★★★★★★★★★

SECOND FRONT PHOTOGRAPHS

Because many readers of Natural History are travelers, attention is called to the fact that the Office of Strategic Services is on the hunt for photographs showing the terrain of foreign lands that may possibly become theaters of war. All photographs from a European tour or world cruise which show landscapes, harbors, beaches, docks, factories, oil depots, and railroads are sought. The pictures themselves should not be sent at this time. Send an outline of what you have to the Office of Strategic Services, Station G, Box 46, New York City.

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INFORMATION TEST

A few high spots in this issue on which you can try your knowledge.

Correct answers on page 276

1. Does a baby elephant nurse with its mouth or its trunk?

2. Would you expect to find thermite in
   a. A bomb that hits your roof,
   b. The thermometer on your front porch,
   c. The timbers in your foundation.

3. Will teak float?

4. A flying fox is not a fox at all. What is it?

5. A female elephant carries her young
   a. nine months
   b. two years
   c. five years?

6. It is the ore of aluminum that is strategic, not the refined metal.
   True.......... False..........

7. When an animal sleeps all winter instead of eating, it uses up most of its fat.
   True.......... False..........

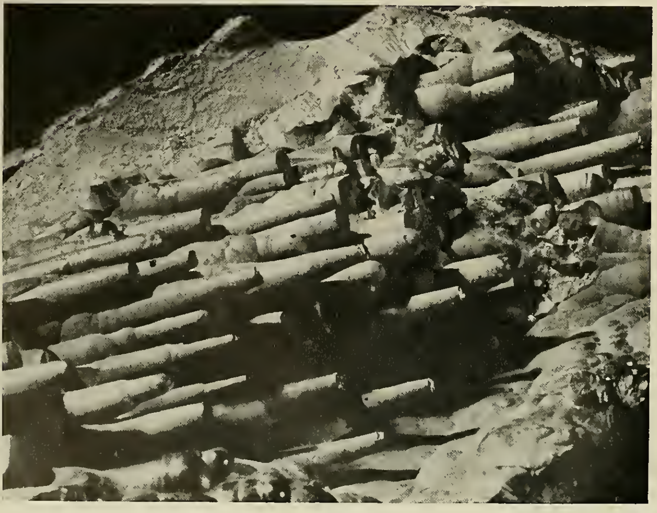
8. Buffalo Bill never slew a single buffalo.
   True.......... False..........

9. When a woodchuck hibernates, its body temperature, normally about the same as ours, falls to:
   a. 73° F.
   b. 73° C.
   c. 37° F.
   d. 37° C.

10. Since 7% of the earth's crust is aluminum and few elements are more abundant, why is it of strategic importance?

11. The photograph below depicts (a) The guns of Bataan, (b) unfinished rifle cartridges, (c) the ferric sinews of war?

AMNH photo by Coles



coast from Perth in the southwest to Thursday Island, which lies in Torres Strait off the most northerly tip of Australia. She visited thriving pearl fisheries and deserted mining towns and talked with old prospectors and lonely station managers, gathering tales of adventure, romance, and violence.

Many parts of this northwest coastal region are blessed with a wealth of gold and other minerals but cursed by hurricanes, droughts, and floods. Pearlfishing brings a good living to many and wealth to a lucky few, while cattle raising is carried on extensively and meatpacking is an important seasonal industry. Men work against fearful odds in this wind-swept land where whole towns blow away and boats are lost at sea during the worst storms.

Aborigines live there in semiwildness, working for the white men in mines and on cattle stations. They cling to their old tribal rituals and corroborrees. These native dances are a reënactment of important events and may be dramatic, humorous, or burlesque.

Jumping from the Northern Territory to Central Australia, Miss Hill traveled north from Port Augusta across the saltbush plains, which are treeless, waterless, and level as the ocean. She tells absorbing tales of camels and Afghans; of opal diggings and an underground community; of a gold rush, and of an English woman who married an aboriginal and has lived among her husband's people for many years.

YVONNE RAVEN.

NEGROES IN BRAZIL

by Donald Pierson

University of Chicago Press, $4.50

ONE of the inescapable consequences of the overflow of Europe after 1492 was the establishment of contact between racial groups that had previously been isolated from each other. This process was nowhere more significant than in the New World, although important centers of race contact and miscegenation grew up in various parts of the newly discovered Old World. It would be a mistake to regard these foci of contact as of parochial interest only. On the contrary, they have an enormous significance in a world where distances are rapidly shrinking and transportation is becoming increasingly easy. They are tokens of a process that is likely to spread over a much greater part of the earth than they now affect.

Mr. Pierson has selected Brazil as one of these areas of contact and has described in some detail the history and nature of the relationships among Indian, Negro, and White. Most of his discussion, however, necessarily hinges upon the two latter groups since the Indians constitute a relatively minor group. Nowhere in the New World did the traffic in Negro slaves exceed the numbers imported into Brazil. Moreover, slavery nowhere else in the New World continued as late. In spite of these circumstances, or perhaps because of them, Mr. Pierson finds that the Negroes of Brazil enjoy a much more equable position in Brazilian life than in the United States or South Africa. The picture Mr. Pierson draws of the social status of the Bahian Negro of Brazil is of great importance in understanding the relationships of the Negro elsewhere.

H. L. S.

MEET THE NATIVES

- - - - - by M. Walter Pesman

Published by the Author,
3722 South Humboldt St.
Denver, Colo.
$1.25

THE author, who is an instructor at the University of Denver, has prepared a most usable and attractive little book for identifying wild flowers, trees, and shrubs of the Central Rocky Mountain Region. He begins his introduction as follows: "Dear Plantlover: Just between you and me—don't buy this book if you know too much. This is not a book for botanists."

Over 700 plants are classified,—first, according to life zone where the plant grows; second, according to color; and third, according to season. More than 150 of the more conspicuous or striking plants are illustrated by good, clear pen drawings. Those of similar color and common to the same zone are grouped on the same page. Some 50 other plants are illustrated by excellent photographs.

The first or major grouping is by life zones as they occur in Colorado: Plains Zone from 3,500 to 6,000 feet elevation; Foothill Zone from 6,000 to 8,000 feet; Montane Zone from 8,000 to 10,000 feet; Sub-alpine Zone from 10,000 to 11,500 feet; and Alpine Zone from 11,500 feet to the tops of the highest peaks.

Under each life zone, the plants are grouped according to color of flowers, and are described on pages of appropriately colored paper. For example, trees on green paper; red, pink, and reddish-purple herbs on pink paper; white herbs on white paper; blue and bluish-purple herbs on blue paper; yellow herbs on yellow paper. This unique device saves time in looking up a plant.

CLYDE FISHER.

EVOLUTION OF BOOKBINDING

A special exhibition of books bound in wild animal skins, will be shown at the American Museum of Natural History, from December 2nd through January 20th. The books were bound by Hamonneau, master binder, who has utilized lion, rhino, elephant, skunk, and about 25 other skins. The exhibition will demonstrate the development of the uses of various materials, from the parchment of 1,000 years ago, to present-day bindings.

HAND COLORING YOUR PICTURES

Continued from page 270

taken under flat illumination caused a great deal of comment by their close resemblance to direct color pictures, for which they were often mistaken at first glance.

Coloring Pictures

Transparent oils are the easiest type of coloring to use because mistakes are not fatal. If one color accidentally runs over onto another, it may be removed readily and the coloring reapplied. Large areas like the sky may be covered smoothly with no more trouble than merely rubbing the color over the area with a tuft of cotton. Of course, a deep gray sky such as is obtained with a heavy filter is very difficult to color. The sky as produced by an orthochromatic film without a filter—that is, a very light or even white sky—is preferable. If a picture with a gray sky must be used, it might simplify matters to tone the entire print blue chemically before coloring it.

While it is recognized that there is nothing like a direct color picture for accuracy, beauty, and simplicity, there should be no reason to overlook the opportunities that hand coloring can open up as a substitute for direct color photography. The work itself is creative fun for otherwise empty winter evenings, and a carefully done job is a close approach to a real color picture—so close that many of the pictures you see in magazines and assume to be direct color shots are really hand colored.

THE COVER THIS MONTH

The delicate glass model on the cover of this issue represents the small one-celled animal *Lychnosphaera regina*, greatly enlarged. This tiny protozoan inhabits the surface waters of the Central Pacific. It has a lattice-like glassy skeleton of fragile beauty surrounding the rose-colored clustered lobes of the living animal in the center. Threadlike filaments radiate in all directions to capture still smaller creatures.

The model was created by Herman Mueller, the American Museum's skillful glass blower, under the direction of Dr. Roy Waldo Miner, whose article on page 252 describes the universe of minute creatures that is revealed by the microscope. Mr. Mueller is shown below assisting Charles H. Coles, the Chief Photographer, in photographing the model in color. The model was rested on a plate glass platform under the carefully adjusted beams of five spotlights. Three filters were used, one of them polarized to control reflections. The most highly color-corrected lens available was stopped down to a pinpoint, and an exposure of fifteen minutes was given.

NATURAL HISTORY
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Photographed by Charles H. Coles

Continued from page 225

used an electric outfit all the time to get worms from lawns and flower gardens where no spade could be used. It is part of the fun of a fishing trip to get worms electrically!

ROY PAINTER.

Twin Falls, Idaho.

SIRS:

The article entitled "Do You Believe Them?" in the November issue of NATURAL HISTORY, prompts me to relate my own experience in "fiddling" for earthworms, which was limited to the sandy soil of West Florida.

First, we selected an area showing "signs" of earthworms, that is, the castings about the openings of their burrows, which were very evident on the bare patches of sandy soil. Then we drove a wooden stake into the ground, the stake having been made of a board an inch or less thick and some four inches wide. Another board of similar thickness and width and some three or four feet long was then rubbed across the top of the stake at an angle that would cause the stake to vibrate. Sometimes a flat piece of rusty iron was used instead of the wooden board for rubbing.

I should like to give the result of one selected "fiddling." On a clear, sunshiny day, when no earthworms were to be seen on the surface of the ground—although there were plenty of "signs"—, two companions and I picked up 84 earthworms within a few steps of the stake and within a few minutes of the beginning of the "fiddling." Although this is the most striking case in which I counted the earthworms, I used this method repeatedly and with success.

CLYDE FISHER.

New York, N. Y.

Thus there is conflicting evidence on both methods discussed in November for getting earthworms to come up. Water will certainly encourage them to do so, and anyone who undertakes to test the efficacy of any artificial aids should take this factor into account.—ED.

* * *

Sirs:

In connection with the ancient story that bees can be born out of the bodies of lions, the author of "Knothole Cavern" in the October NATURAL HISTORY, may be amused by the trademark of one of the oldest food firms in England. The labels of the Lyle Company—makers of syrups and honeys—depict a dead lion enveloped by a swarm of "bees," with the motto: "Out of strength cometh forth sweetness."

ROBERT MARSH, JR.

Tucson, Ariz.

* * *

Sirs:

. . . Your publication is a great joy to our school . . .

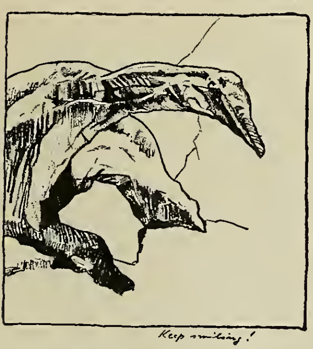
GLADYS M. BATES.

Great Neck, N. Y.

Sirs:

With great interest I read Dr. H. E. Vokes' explanation of how Nature carved the natural bridges.

As I am not a scientist but only a dreamy artist, I have my own ideas about the origin of Twinbow Arch, depicted on the cover of NATURAL HISTORY. I am convinced that a nice old dinosaur knew already about the slogan "Keep smiling," and consequently kept smiling in a most pleasant pose—until he got petrified.

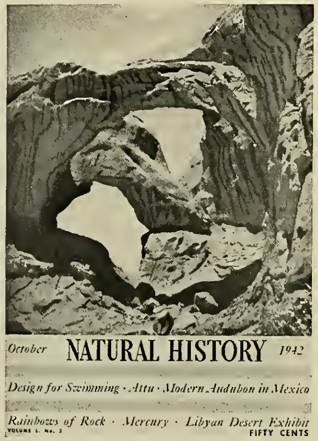

Keep smiling!

I won't require that you accept my hypothesis, even though you will note that this drawing is traced directly from the old beast, without changing a line. But maybe you can use it as a warning not to seize upon the most obvious explanation when dealing with scientific problems.

Moreover, I want to tell you that NATURAL HISTORY is the magazine I am always waiting for like a child for Christmas.

ALEXANDER SEIDEL.

Plainfield, N. J.


October NATURAL HISTORY *1942*

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Rainbows of Rock · Mercury · Libyan Desert Exhibit

VOLUME L, NO. 3

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daschund standing

longhorn steer
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stegosaurus
cat sitting up
cat lying down
turtle
seahorse
frog
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setter
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squirrel
yearling head up
yearling head down
lion
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Answers to Questions on page 274

1. A baby elephant curves its trunk back and takes nourishment from its mother with its mouth. See page 232.
2. You would expect to find thermite in an incendiary bomb, for it is the substance that burns with tremendous heat. See page 246.
3. When fresh, teak will not float, but seasoned logs will. See page 230.
4. A flying fox is a bat. See page 250.
5. A female elephant carries its young approximately two years — 20 to 24 months. See page 231.
6. True. Most of the ore must be imported, whereas we process it without great difficulty in this country. See page 244.
7. False. Contrary to general opinion, a hibernating animal uses up very little of its fat. Its heart may slow down to seven to ten beats a minute, and very little oxygen is used by the tissues. See page 247.
8. True. The animals Buffalo Bill hunted were, strictly speaking, bison. See page 251.
9. The body temperature of a hibernating woodchuck falls to only about 5° above freezing, or 37° F. See page 247.
10. Aluminum is of strategic importance not because of its scarcity in nature but because it is not readily recoverable from most of its compounds and because the richest deposits lie outside of the United States. See page 244.
11. The object depicted is one of the sinews of war, a specimen of the important ore of iron known as limonite, from Dutchess County, New York.